NOVEMBER, 1938

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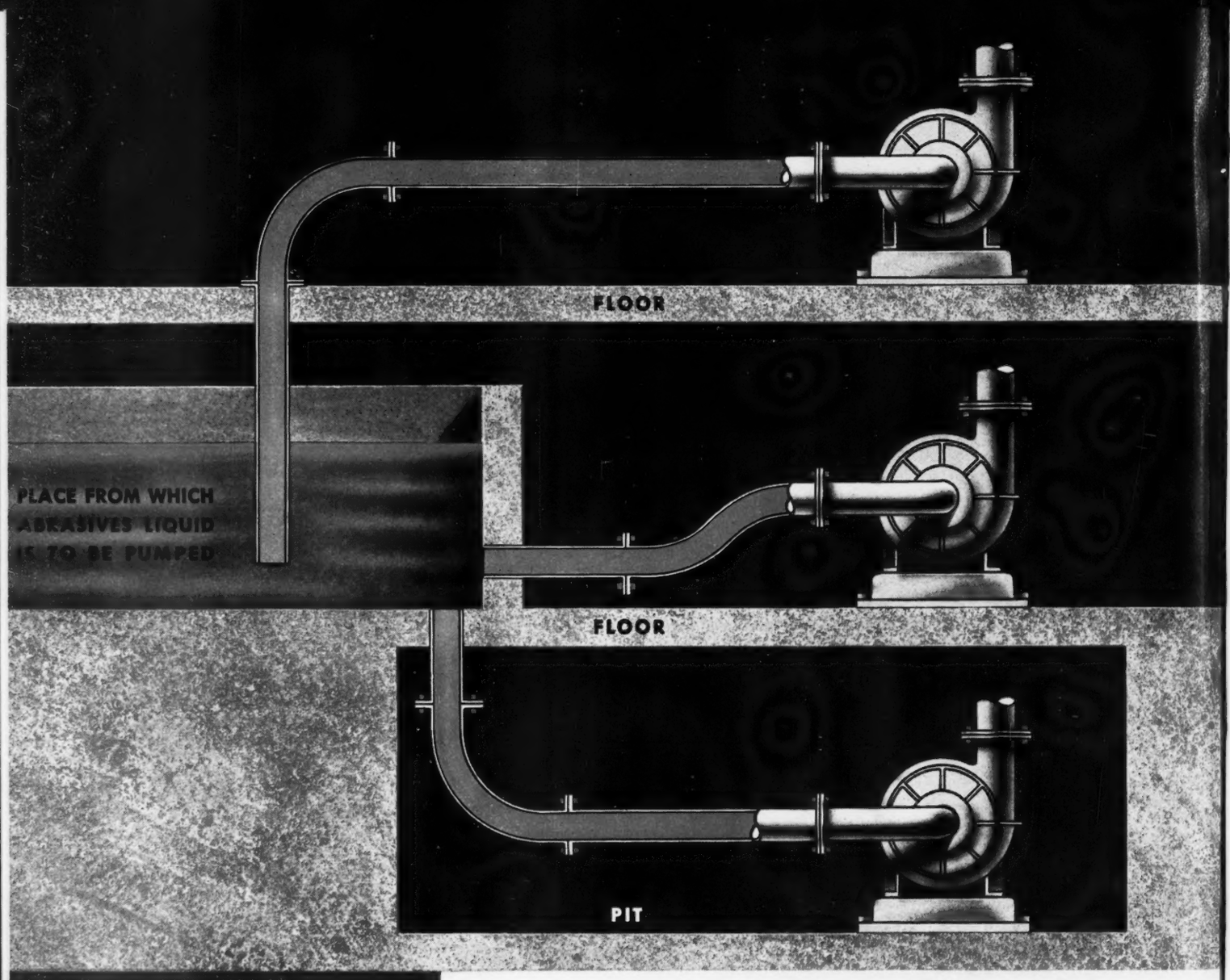

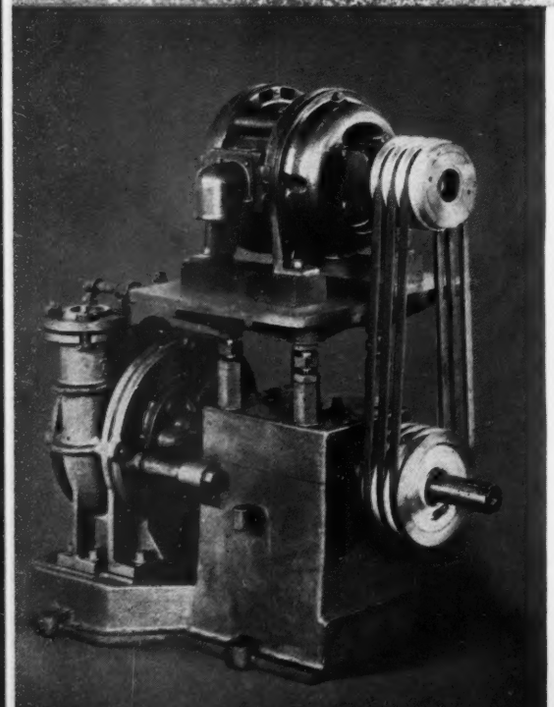

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Volume 139 Number 11

NOVEMBER 1938

Outlook for Mining

OCTOBER witnessed a marked revival of activity in the mining industry, and the prospect is fair for continued improvement. Sales of major non-ferrous metals increased substantially at higher prices, as reported in our market pages. Employment rose and mine production continued to approach normal capacity following the curtailment in August. The industry absorbed the war scare of late September in good shape, and there are many indications that the forces of recovery are again taking hold. The rate of steel ingot production has risen to 61 per cent of capacity in early November from a low of 26.1 per cent in June. Electric energy consumption has shown a decided increase, and the Federal Reserve index of industrial production has climbed from a low of 77 in June to above 90 for October. Economists expect this index to reach 100 by next Spring. A noticeable shift in sentiment to moderate optimism has accompanied these statistical changes.

One of the reasons for further expected improvement in general business is the tremendous artificial stimulation resulting from government spending. Whether we approve or disapprove the financial policies of the Administration that result in a badly unbalanced Federal budget, the fact remains that the tempo of government spending is increasing and is not likely to reach its peak until late Spring or early Summer of 1939. This is an inflationary influence of great magnitude, measured by the monthly cash deficit in the Treasury, and must of necessity result in pouring hundreds of millions of dollars into the channels of trade and commerce.

Another factor in the business outlook is the improvement in the national income. For October it was still ten per cent below that of the same month in 1937. But competent economists estimate that by March, 1939, it will be about eight per cent above that of the same month this year. This represents a shift within six months for which there is no precedent in our economic history. The prospective rise is as sharp as was the recent recession.

A third evidence of general recovery is the upward trend in construction that began last Summer. Contemplated building for the first half of 1939 is reported to be substantially higher than for the first half of 1937, which was a good half-year. Finally, the automobile industry, which has so frequently "carried the ball" in the last few years, has experienced a reversal of sentiment in the past sixty days and is now hopeful that 1939 will show a marked increase in production over 1938.

All these are favorable indications for the next six to eight months. They portend a rate of improvement and revival much faster than usual and point to an immediate future of substantial promise in which the mining industry should share. With industrial production and construction on the uptrend, metals should be in proportionately greater demand.

Labor Looks at Taxes

FOR SOME TIME PAST we have had a strong conviction that what the labor element of American industry needs most urgently is more economics and less legislation, more facts and fewer slogans, a realistic rather than an emotional approach to mutual understanding with all the other elements of our economy. Perhaps this feeling has been emphasized by recent reports of the President's commission to study labor policies in England. There it is evident that labor has more intelligent and less belligerent leadership, and has finally learned the technique of bargaining with employers on the basis of national and industrial economics. Under such conditions mutual interests of employer and employee stand out in strong relief and point the way to conciliation and adjustment of differences.

So it is heartening to receive from the Florida Federation of Labor a report of a special committee to study labor's interests in, and attitude toward, "dangerous and powerful trends in tax problems . . . against the interests of the silent taxpayer." The study was concerned primarily with the distribution of consumer goods through chain stores; and the belief was expressed that "the Patman bill and state and

local punitive tax or control bills directed against chain stores should be opposed by labor." Further, the report recommended additional study and ascertainment of facts, not only in Florida, but through tax study committees of other state federations. Finally a practical set of principles was laid down with respect to current and future taxation.

As the Secretary of the Florida Federation said in his letter to the editor, this report "is unique in labor's history." It is "the result of four months' exhaustive study . . . of the effect of taxes on wage levels, living costs and employment." Continuing, he says: "Many of us in organized labor feel that labor is the natural partner of you in industry, rather than of the politicians. Many of us are confident that labor and industry together could put an end to this present trend toward taxes and legislation which, by cramping or paralyzing business, affect us adversely too."

We commend the soundness and wisdom of the Florida Federation of Labor in its studious approach to economic and business problems. Its attitude may well be emulated by labor leaders everywhere. Only through impartial study of facts will labor find common ground of understanding with industry and achieve its desire for general prosperity and a fair distribution of national income.

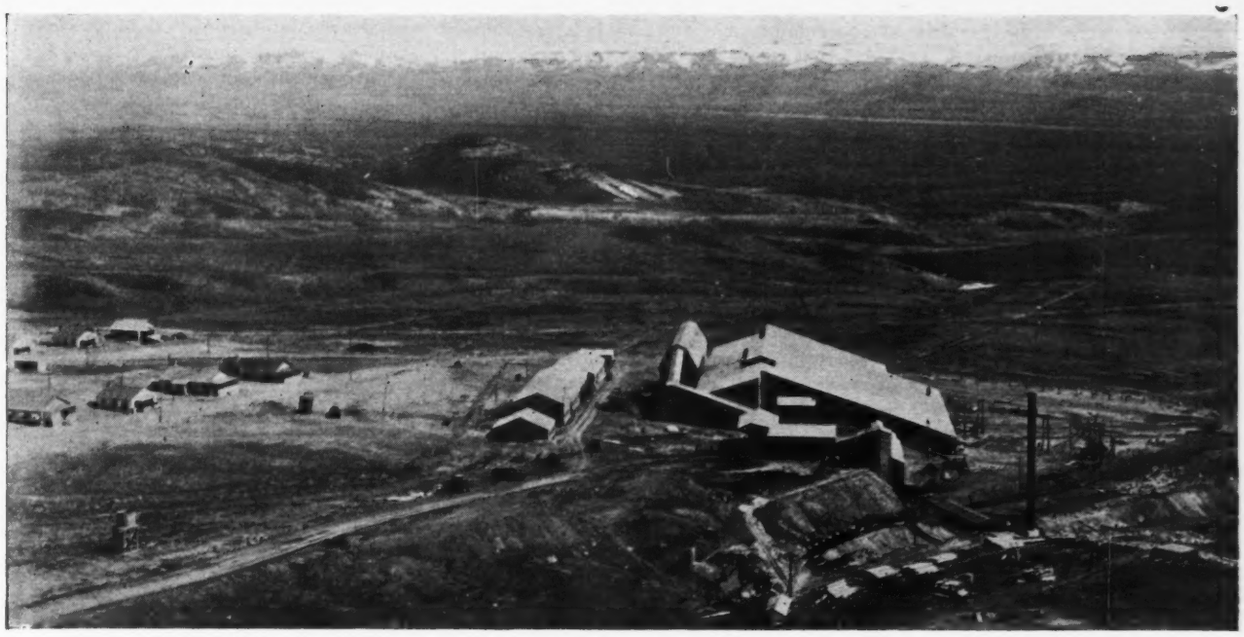
Fire in the Mine Workings

NOT that the unexpected always happens, but that one may be better prepared for it if it does, the possibility of mine fires should never be overlooked. Twice recently the topic has been discussed before gatherings of engineers, once when a representative of the National Board of Fire Underwriters dealt with it at Noranda, and again when one of Anaconda's mine officials spoke on it at Butte. True, little can be said about fire prevention underground that has not been said repeatedly. The Bureau of Mines has been full of the subject, so to speak, for years. And yet, save for those camps or mines where the fire risk looms larger than elsewhere and past history is a spurring factor, many of the safeguards prescribed by experts are commonly neglected.

Fire always surprises. No one expects his house to burn. And many companies seem to feel likewise about a fire in their workings. Mill and surface plant where the risk is evident receive due attention. But the mine is different. Rock walls suggest perhaps that the "house" is fireproof. Yet mine fires start like others and, according to statistics, 65 per cent of them in shafts and stations and drifts, all readily inspected. Time of occurrence is most commonly just after the shift has gone. Increasing use of electric power underground places increasing responsibility upon mine management. Wiring and connections should be made and maintained with utmost care. Here attention is called to C. D. Woodward's article, elsewhere in this issue, on the practice with respect to electric power in Anaconda's mines at Butte. Mine fires, moreover, kill where the flame is never felt. Asphyxiation and poisoning result from smoke and gases borne on the air stream that flows through the workings, something to be kept in mind today when ventilation and air conditioning are getting such attention, with stress being placed on the need of a large volume of air at sufficient velocity for proper results. Important is the adequate training and instruction of the personnel so that the right thing may be done in case of fire. This presupposes the existence of adequate fire-fighting equipment in good condition.

Hospitalization at Climax

PROVISION for medical and hospital service for employees is of primary importance in the industrial relations program of mining companies. Next to adequate safety and sanitary measures and other preventive means of protecting the miner against physicial disability, hospitalization ranks high among the factors that contribute to his peace of mind as well as his bodily welfare. In the very nature of the mining business many operations are carried on at places remote from large centers of population where hospital facilities are right at hand. This means that the mining community must be self-sufficient in this as in many other personal services. Even if occupational hazards are safely avoided, members of the community are still subject to non-occupational diseases that seem to afflict mankind wherever located, and which call for prompt and skillful treatment. The need is particularly urgent for women and children. As an example of the way in which one mining company, among others, makes hospital service available to employees, we publish this month an illustrated description of the hospital of the Climax Molybdenum Company, at Climax, Colorado. Located high in the Rocky Mountains at an altitude of about 11,000 feet, the mining community of Climax would be without this benefit if the company did not provide it. As a factor in creating and maintaining good relations with its employees, the hospital must play a conspicuous part.



THE GETCHELL MILL from the outcrops on the hillside. Down the slope in the foreground is the portal of No. 4 tunnel

The Getchell Mine

New Gold Producer of Nevada

Now cyaniding 500 *tons of oxidized and tungsten-bearing ore and* 150 *tons of sulphides daily, with preliminary roasting for the latter. Both quarrying and underground stoping employed*

Roy A. Hardy
Consulting Engineer
Reno, Nev.

THE GETCHELL MINE, in Humboldt County, Nev., is in the foothills flanking the east side of the Osgood Range, at an elevation of 5,700 ft. above the sea. The property is connected by well-graveled roads to two rail terminals, Golconda, 28 miles northeast, and Red House, 16 miles north, both of them stations on the main lines of the Southern Pacific and Western Pacific railroads. Red House is the railroad station for the mine, and Golconda is the postoffice.

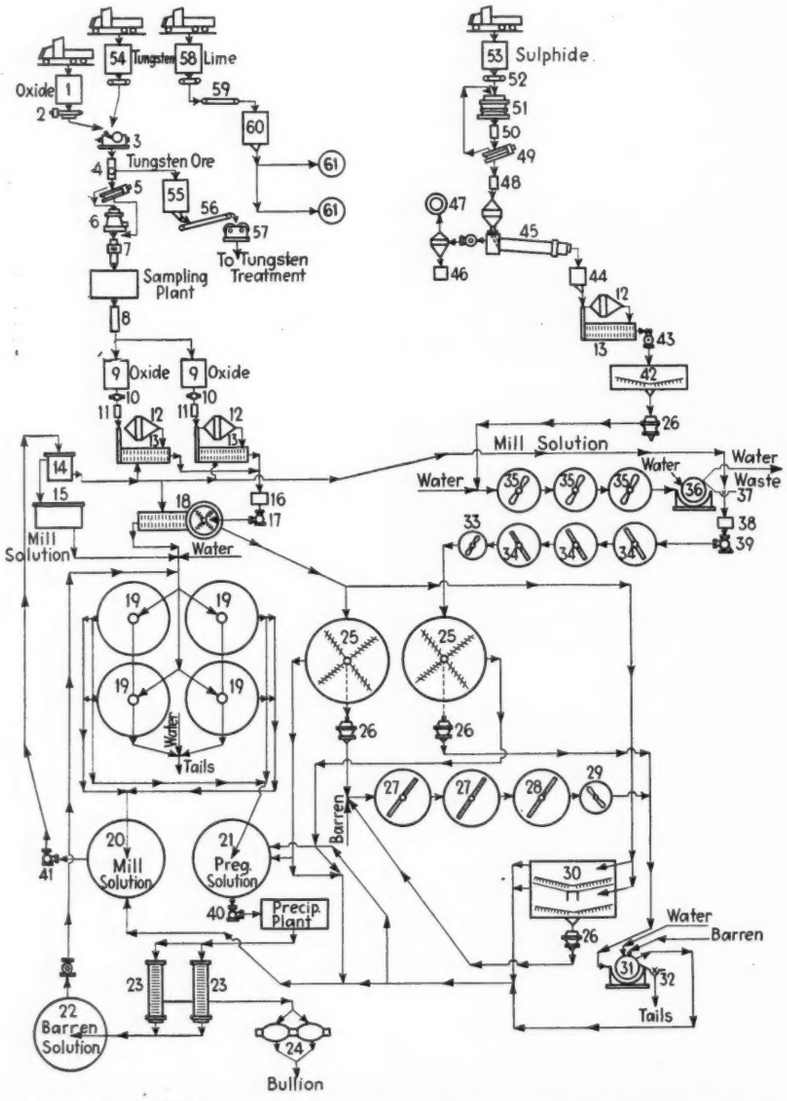
Osgood Range is one of the north-south ranges so common in the Great American Desert basin, with a length of about 20 miles and a width of some 8 miles. Adam Peak, with an elevation of 8,500 ft., is the highest in the range. At times, snow remains on it and on the ridges until summer. Drainage is to the valleys on the east and west side through east-west canyons and draws. The winters are somewhat severe from the middle of December until March. The rest of the year is typical of the desert.

Domestic water for the camp is obtained from springs above the mine, and water for milling is pumped at the rate of 260 g.p.m. from a 400-ft. well drilled in the valley floor east of the mine at Kelly Creek, 1,000 ft. below the mill and 6 miles distant. Electric power is obtained from the Sierra Pacific Power Company over a 60-cycle, 60,000-volt line. It is generated in several hydro-electric power plants along the Truckee River above Reno, and is also furnished at times from the Sierra Pacific Power Company's tie-in connection with the Pacific Gas & Electric system in northern California.

The property was located in 1934 by Emmet Chase and Ed Knight, two prospectors. They had been investigating some old mining properties in the Potosi district, in the Osgood Range, supposedly silver prospects on a granite limestone contact. Their tent camp was in the gulch upon the Getchell croppings, which were covered at that place with wash. This bold outcrop is a prominent feature of the landscape. Prospecting these croppings by panning had given negligible results, as the gold is invisible in the concentrate. Before abandoning their work in this area, Chase and Knight took samples for fire assay, which returned results low in gold but sufficient to justify development. Noble H. Getchell became interested and was asked to buy the property. He obtained the assistance of George Wingfield in financing development. Getchell Mine, Inc., a Nevada corporation, was formed with Wingfield as president and Getchell as general manager. The holdings have grown from the original three claims until they now embrace several thousand acres.

The area in which the mine is situated forms a roof pendant. Country rocks making up the Osgood Range include a metamorphic sedimentary series of quartzites, shales, limestones, and schists of probably Paleozoic age. These rocks have been invaded by a batholith of granitic rocks of the Jura-Triassic age in the central part of the range, with numerous intrusive bodies of granite extending into the sedimen-

taries. These were tilted easterly and westerly by this intrusion. A second sedimentary series was laid down unconformably upon these earlier formations. These later rocks consisted of quartzites, conglomerates, limestones, and shales, all bleached to a very light color, and probably of Mesozoic age.



DIRECT CYANIDATION for the oxidized ore and roasting followed by cyaniding for the sulphides feature the flowsheet of the 600-ton mill at the Getchell mine

They are now exposed as flat, east-dipping beds on the lower flanks of the Osgood Range below the mine. Erosion has exposed the granite in the central area of the range as well as the tilted Paleozoic beds on the flanks of the granite. Several Tertiary intrusions of andesite and rhyolite occur both as dikes and flows in the sedimentaries. Block faulting is common throughout the range, with normal faults along its flanks.

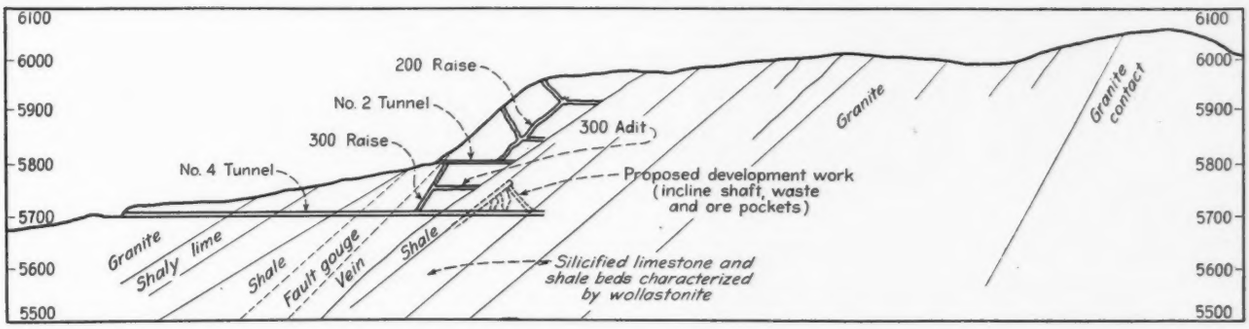
Two types of orebodies exist. The known gold deposit occurs in a shale bed in the Paleozoic series. This shale has a thickness from 50 to 200 ft. and is 500 to 2,000 ft. east of the granite-metamorphic contact. It is this deposit that is being developed and mined. The second type is due to contact metamorphism and has lenses of tungsten ore (scheelite) at intervals along the contact. These tungsten deposits have been only partly prospected and developed. The gold deposit in the shale dips at 40 deg. to the east, strikes northwest-southeast about 15 deg., and lies conformably upon a dark-blue limestone bed characterized by numerous wollastonite crystals. Normal faulting and buckling of the beds is common.

Within the vein considerable post-mineral strike faulting has taken place, resulting in shearing and overlapping. On the hanging side of the shearing is a typical bedding fault with 20 to 30 ft. of ground-up shale gouge. Several periods of mineralization may be distinguished in the shale bed. The gold was in an early deposition of silica and pyrite, which was followed by a very late deposition of gold-free arsenic sulphide during the last stages of vulcanism. In certain areas the shale bed outcrop is completely silicified and has a siliceous shell so common in the desert where secondary silica deposition has taken place. Quartz is the predominating non-metallic constituent of the ore. Much of it is very dark in color, as would be expected from the fact of the replacement of the shale by silica and an absence of quartz veins. Minerals identified are gold, silver, realgar, orpiment, pyrite, and small quantities of arsenopyrite, along with their oxidized products.

LEGEND

1. 300-ton ore bin (oxide)
2. 30-in. vibrating feeder grizzly
3. 18x36-in. jaw crusher
4. 20-in. belt conveyor with magnetic pulley
5. 4x12-ft. Symons double-deck screen
6. 2 ft. 4-in. TY Traylor gyratory crusher
7. 20-in. belt conveyor with Merrick Weightometer
8. 20-in. belt conveyor with tripper
9. 500-ton fine-ore bins
10. Hardinge Constant-Weight feeders
11. 20-in. belt feeders
12. 7 ft. by 48-in. Hardinge ball mills
13. 5 ft. by 28-ft. 6-in. Dorr DSFX classifiers
14. 12x10-ft. mill solution steady-head tank
15. 46x14-ft. mill-solution tank
16. Sump
17. Sand pumps (2) (Wilfley)
18. 8 ft. by 41 ft. 8 in. by 25-ft. Dorr bowl classifier
19. 46x16-ft. sand-leaching tanks
20. 42x10-ft. mill-solution tanks
21. 42x10-ft. pregnant-solution tank
22. 43x10-ft. barren-solution tank
23. 36-in. presses (22 frames each)
24. Monarch furnaces
25. 45x16-ft. Dorr thickeners
26. Diaphragm pumps
27. 22x16-ft. Dorr agitators
28. 20x16-ft. Dorr agitator
29. 8x8-ft. conditioner
30. 45x16-ft. Dorr tray thickener
31. 14x16-ft. Oliver filter
32. Repulper
33. 8x8-ft. conditioner
34. 16x16-ft. Dorr agitators
35. 16x16-ft. Devereux agitators
36. 5 ft. 4 in. by 10-ft. Oliver filter
37. Repulper
38. Sump
39. Slime pump
40. Pregnant-solution pump
41. Mill-solution pump
42. 30x12-ft. Dorr thickener
43. Wilfley sand pumps (3 in.)
44. 30-ton surge hopper
45. 7x100-ft. rotary kiln with 100-ton surge tank
46. Dust collector
47. 80-ft. stack
48. 20-in. belt conveyor
49. 30x68-in. double-deck vibrating screen
50. 20-in. belt conveyor
51. Dixie hammer mill
52. 24-in. pan conveyor
53. 300-ton sulphide ore bin
54. 300-ton tungsten ore bin with 20-in. belt feeder
55. 100-ton tungsten fine-ore bin
56. Belt feeder
57. Rolls
58. 150-ton lime bin with 20-in. belt feeder
59. 20-in. feeder belt
60. 50-ton bin
61. Emulsifiers

Prospecting and development were done with a number of crosscut tunnels from the hanging-wall side through to the footwall in the upper part of the vein in the shale bed over a length of about 2,000 ft., with one of the crosscut tunnels gaining a depth of nearly 400 ft. This tunnel intersected the orebody 500 ft. from the portal and 400 ft. below the croppings on the dip of the bed, from which drifts were run in a northerly and southerly direction, with raises and crosscuts at regular intervals. The lower tunnel serves as a haulageway to the mill, an all-steel building situated 1,000 ft. east of the portal. The croppings readily lend themselves to quarry mining. Primary breaking is done principally with coyote holes.



SECTION through the main haulage tunnel of the Getchell mine. Prospecting and development have been done with crosscut tunnels

The shale, with its 20 to 30 ft. of gouge in the bedding fault, presents a condition calling for careful consideration of stoping methods. Several will be tried on their merits, but at present a square-set stope has been started, which will be followed by a cut-and-fill method in another section of the mine.

About 500 tons of quarried ore goes daily to the oxide plant for treatment, and 150 tons of sulphide material to the sulphide circuit, which includes a roaster plant. The oxidized ore can be cyanided directly, whereas about 50 per cent of the gold in the sulphides is refractory and cannot be so treated. Owing to the presence of arsenic minerals, and the locking up of the finely divided gold in silica and the coating found on the gold particles, all sulphide ores are given a low-temperature roast of 1,500 deg. F. for one hour and fifteen minutes preparatory to cyanidation.

The calcines are then washed with water after grinding, to rid them of deleterious salts, and are then cyanided. Two separate circuits are used in the treatment of the ore. The sulphides are transported from underground loading stations in 50-cu.ft. cradle-type cars drawn by a 2½-ton storage-battery locomotive, and the oxidized material is hauled by trucks in 8-ton loads to 300-ton circular concrete bins.

Because of the heavy gouge in the sulphide zone which carries gold values, all sulphides are crushed in a No. 3620 Dixie hammer mill with a traveling breaker block operating in closed circuit with a vibrating screen. The screen undersize, a ¾-in. product, goes direct to the roasting kiln, 7 ft. in diameter and 100 ft. long. Lining consists of asbestos bricks and fireclay bricks. Kiln equipment also includes a Sirocco cyclone dust collector. The roaster gases are taken through a 10x10x30-ft. concrete chamber provided with baffles, where the arsenic is precipitated out as an arsenic trioxide, and then discharged to the atmosphere through an 80-ft. stack. The trioxide is not recovered but is flushed out of the concrete chamber into a settling pond.

The calcines proper are discharged into a small surge bin, whence they are fed directly to a 7 ft. by 48-in. Hardinge ball mill in closed circuit with a Dorr FX classifier. Grinding is done in water, to minus 65 mesh. The calcines are quenched with water in the scoop feed of the ball mill. The temperature of the feed entering the mill is about 300 deg. F., and the classifier overflow is some 150 deg. F. Overflow from the classifier is pumped by a 3-in. Wilfley rubber-lined pump to a 30-ft. thickener, where the pulp is thickened to between 60 and 70 per cent solids.

This operation is followed by agitation, in water, in three Dorr agitators, and filtration on a 5 ft. 10 in. by 10-ft. Oliver filter. The resultant cake is emulsified in a cyanide solution, and after agitating, thickening, and washing, the calcine pulp joins the oxide pulp for final filtering on 14x16-ft. Oliver filters. The calcine wash water carrying the deleterious salts is used to help transport final tailings from the mill.

From the bins served by trucks, the oxide ores are fed by a Jeffrey vibrating feeder to an 18x36-in. Traylor jaw crusher, to be reduced to minus ½ in. This material next is screened out on a 4x12-ft. double deck Symons screen, the undersize being conveyed by belt to two circular, all-steel fine-ore bins, each of 500 tons' capacity, and the oversize going to a 2 ft. 4 in. Traylor TY reduction gyratory crusher set to give a minus ½-in. product. Grinding to 30 mesh is done in two 7 ft. by 48-in. Hardinge ball mills fed by Hardinge constant-weight feeders and operating in closed circuit with Dorr FX classifiers. The overflow from these is pumped by a 4-in. Wilfley rubber-lined pump to a 25-ft. Dorr bowl classifier, where the sands and slimes are separated. The sands amount to about 68 per cent of the feed and contain up to 10 per cent of 325-mesh material. They are leached for six days in four 46x16-ft. steel tanks with center discharge. The slime from the bowl classifier, after thickening, is agitated and subsequently washed in a 45-ft. Dorr tray thickener. This oxide pulp then joins the calcine pulp for final filtering. Merrill-Crowe simultaneous clarification precipitation is used, and the resultant precipitate is reduced to doré bullion in Monarch furnaces.

The operating staff is under the direction of Fred Wise, general superintendent, with Carl Wark, metallurgist.

THE GETCHELL CROPPINGS, looking southwest. One of the development crosscut tunnels intersects the orebody 400 ft. below them on the dip of the bed and 500 ft. from its portal

Fig. 1 . . . CARRYING power and signal cables down a mine shaft at Butte. This is a typical installation for the purpose

Electric Power For the Butte Mines

Normally, 50,000 horsepower is distributed at 2,400 volts within less than a mile from substation

C. D. Woodward
Chief Engineer
Anaconda Copper Mining Company
Butte, Mont.

IN JULY, 1878, according to Francis Jehl in his "Menlo Park Reminiscences," Thomas A. Edison visited some mining regions in the Far West, and noticed difficulties the miners were having in drilling, which operations were frequently adjacent to rapid-flowing streams. Turning to his friend, Professor Baker, he exclaimed, "Why cannot the power of yonder river be transmitted to these men by electricity?" The thought seemed to harass the mind of the great inventor, and soon after returning home he visited William Wallace, a brass manufacturer, at Ansonia, Conn., who had built a machine that made possible the transmission of power by electricity. Mr. Edison's great interest in this machine in the next few years resulted in the development of the central power station, a new distributing system, and the invention of a successful incandescent lamp. The incandescent lamp was, perhaps, the first major assistance the underground miner received from power transmitted by electricity, which later made possible the development of new mines and likewise prolonged the life of many older ones.

Today in the western part of the United States practically all power utilized in the mining industry is generated by the rivers, and, no doubt, the Anaconda Copper Mining Company stands first in the amount of transmitted power used for mining. For Anaconda's copper mines at Butte the company purchases about 50,000 hp. In general, the power is transmitted a distance of more than a hundred miles, and is distributed at 2,400 volts from the power company's receiving stations to the mines, which are within a radius of less than a mile from the substation. Obviously, 50,000 hp. is an appreciable amount of energy to distribute in any locality, but when more than half of this amount must service equipment in working places which are three-quarters of a mile below the earth's surface, there arise many problems in its safe distribution and in the applications of suitable electrical equipment.

In mines, safety and the avoidance of fire risks are the first requisites for electrical installations. As a consequence, power cables should have an insulation factor of twice the normal operating voltage. In shafts and drifts where such cables are subject to mechanical injury, they should be armored with steel, and if the steel armor is exposed to the corrosive action of mine water, each strand of the steel armor should have a protective coating of lead. The armor, aside from protecting the cable from mechanical injury, also has a tendency, in the event of insulation failure, to suppress cable fires, and, finally, a shaft cable should be constructed strong enough to support itself without damage when reasonable lengths are suspended from the top. Such cable on its shipping reel can be lowered onto a mine level, where a clevis and hoisting rope can be attached, and thus the cable can be unreeled and hoisted into the shaft cable compartment, where it is easily swung into bronze supporting clamps which have previously been fixed to the wall plates. Fig. 1 gives a general idea of such construction, but it must be kept in mind that if the shaft is downcast, supports for the cables should be provided on every wall plate for a distance of at least 200 ft. from the collar to sustain additional ice loading during the winter.

Cable splicing in the shaft should be avoided, as it destroys the continuity of cable armor. However, if it becomes necessary to remove the armor for repairs, it should be replaced and the splice covered with a split cast-iron sleeve. For such cable junction boxes should be carefully selected and installed away from combustible material and in places where they will not be damaged by normal mining operations. Probably the most desirable location for them and their connected switch gear is in compartments at least five sets back from the mine shaft. Sometimes on the surface it may be advisable to use current-limiting reactors on large cables, and such cables if operated in parallel should be equipped with directional power relays; and cables of considerable

length should have at strategical points lightning arresters or static dischargers to remove excessive voltage.

Inasmuch as space on stations is always limited, and for other reasons, it is often found that the metal-clad cubicle switchboard has many advantageous features. One advantage is that it will stay in alignment better than other types at load distributing centers where there is a tendency for ground movement. Fig. 2 shows a typical 2,200-volt installation.

If continuous mining operations are expected, considerable care is necessary in the design and installation of the signal system for dispatching skips and cages through the mine shafts. The cables for this purpose should be made up of several conductors having high-grade 600-volt rubber-compound insulation, and each conductor should have a braid of different color from the others, to distinguish the character of circuits in junction boxes. These cables should be lead-armored and over the lead there should be a jute cushion for two layers of steel tape wound in the reverse direction, on top of which should be applied asbestos braiding drawn through flameproof paint. These cables should be clamped in place in the cable compartment similar to the manner in which power cables are fastened, and the wiring from the junction boxes to the pull switches should likewise be lead-covered. A standard signal-cable installation on a mine station is shown in Fig. 3. The open junction box shows the spring contacts, which in the event of trouble permit the isolation of cable section or circuits, and the lamp used to heat the box to eliminate moisture and to indicate the failure of signal power, which on the shaft bells is supplied by storage batteries.

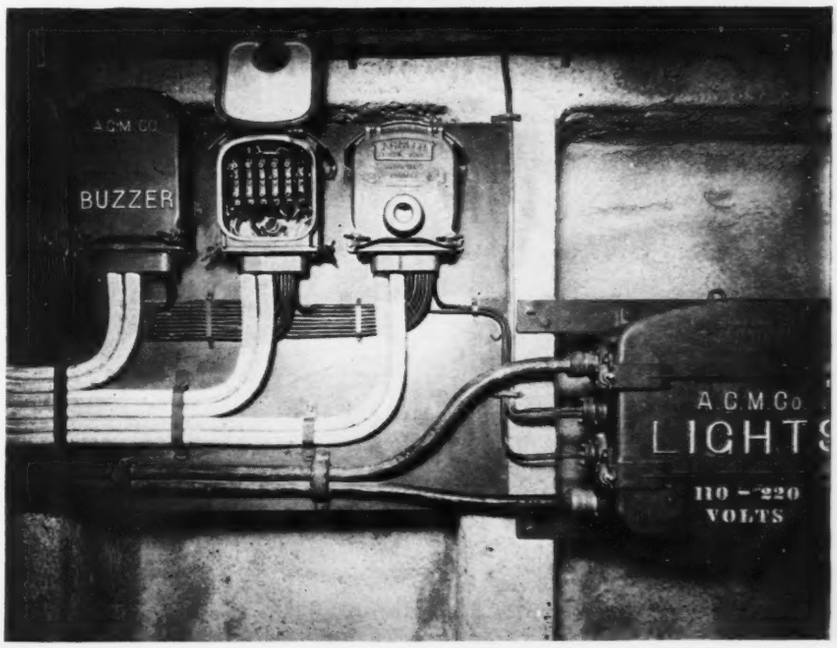
When hydro-electric power became available, it began to supplant steam for driving air compressors, several of which were arranged for rope drives from large induction motors, and later a few large hoisting engines were rebuilt to use compressed air instead of steam. The latter were a decided improvement because the addition of more air compressors made it possible to use cheap hydro-electric power for hoisting, and finally, as a result of the economy, all hoisting was accomplished by this medium. As the mines become deeper and the compressed-air engines fail to give efficient service under new conditions, they will be replaced with electric hoists, of which several now are in operation.

The newer electric hoists have a capacity to lift in balance at 2,250 ft. per minute a skip loaded with 7 tons of ore from the 5,000-ft. level. Such a machine has two clutched drums winding $1\frac{7}{8}$-in. rope in three layers. The drums are driven by a 2,100-hp., 600-volt direct-current motor that is controlled by changing the strength or reversing the direction of field flux in the generator that services the hoist motor. The generator is driven by a synchronous motor adjusted for unity power-factor while idling, but during hoisting operations is over-excited to compensate for drop of voltage in the power feeders. In the event of a power failure at the hoist motor, and to prevent its overspeeding, a relay is arranged to control switches which places across the armature of the hoist-motor sufficient resistance to retard its speed to a value that can be controlled by the brakes. In addition to this there are governors and control mechanism which, if necessary, will permit hoisting operations from push-button stations.

In general, the arrangements of the last hoist installation made are shown in Fig. 4. Inasmuch as noise in the engine room from revolving machinery is somewhat annoying, it will be noticed that the motor-generator set for this hoist is placed in the basement.

Fig. 2 . . . A STATION INSTALLATION (2,200 volts) of metal-clad switch gear for mine-shaft cables. Where space is limited and a tendency to ground movement exists, this type of equipment has advantages

Fig. 3 . . . SIGNAL AND LIGHTING cable junction boxes in a standard mine-station installation. The open box shows the spring contacts, also the lamp used for drying purposes and for indicating signal power failure



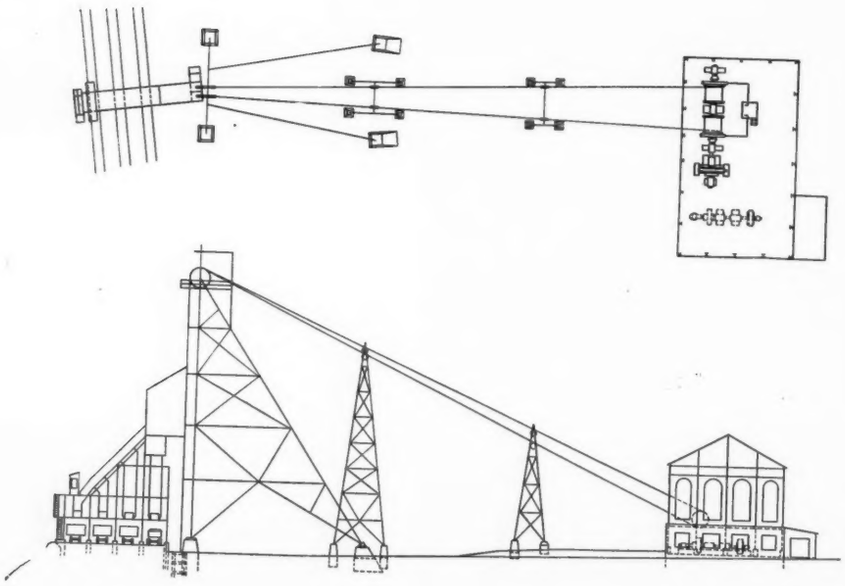


Fig. 4 . . . MOTOR-GENERATOR SET serving the latest electric hoist to be installed by Anaconda at Butte, the general arrangement of which installation, including hoist house, headframe and skip chute, is shown here, is situated in the basement of the building to minimize noise in the hoist room

In order that the latter unit may be serviced by the crane which is used for the hoist, an opening in the floor has been provided and covered with concrete floor slabs, which, if necessary, can easily be removed. Great care has been taken in the installation of all auxiliary circuits and control wiring for this hoist. All such wiring has been brought to a central terminal, and the front of the terminal board, Fig. 5, shows the relative position of the equipment and a diagram in conventional form of the electrical connections. For use in case some of the control or the auxiliary apparatus does not function properly, and to assist in locating faults, several small lamps have been placed on the electrical diagram. They are connected to show by their action the operative condition of various circuits. The scheme avoids the necessity of making hurried tests and contributes toward more efficient operation.

Rope stretch at various depths and during skip loading in the course of

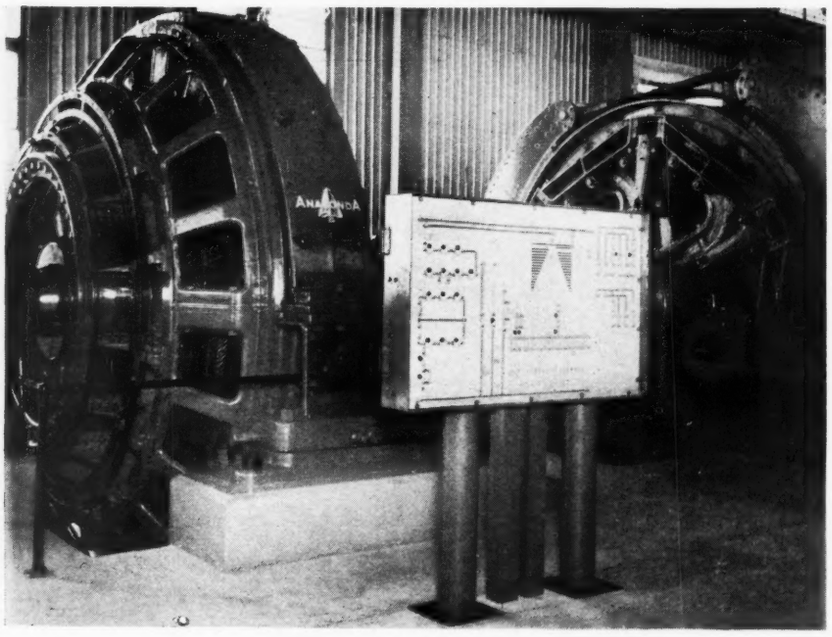


Fig. 5 . . . TERMINAL BOARD for the electric hoist mentioned in Fig. 4. To this point all wiring for the auxiliary and control circuits is brought. The board shows the relative position of the equipment and the electrical connections in conventional diagram. Small lamps indicate the condition of the circuits

balanced hoisting presents a menace. Frequently it changes the relative position of marks on the hoist drums with respect to the position of the skips. As a consequence, to indicate to the engineer accurately the limit of skip travel above the dump, there have been arranged at the limiting points on the headframe photo-electric cells which control the lighting of a lamp at the engineer's station. This combination lessens the risk of accident and increases speed in hoisting.

Often it is not realized that electric power distributed or used underground generates some heat and that this heat must be removed. In the deeper mines most of the electric power is used for ventilation and pumping. **Fig. 6** shows the adaptation of a high-speed and efficient motor-driven pumping unit 3,800 ft. below the surface. These

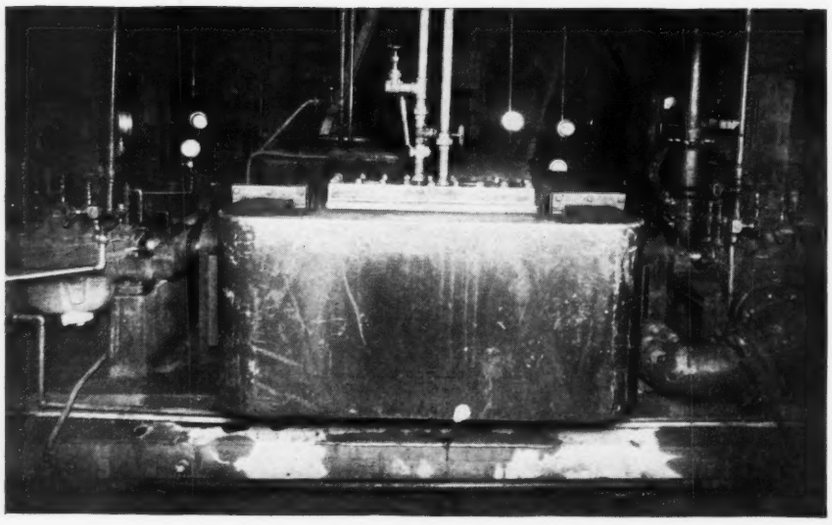


Fig. 6 . . . THE HEAT produced by the sealed 250-hp. motor that drives this station pump on the 3,800-ft. level of the Mountain Consolidated mine is removed with the aid of self-contained fans and a fin-type surface cooler, being finally absorbed by water which is delivered to the pump to be thus removed from the mine

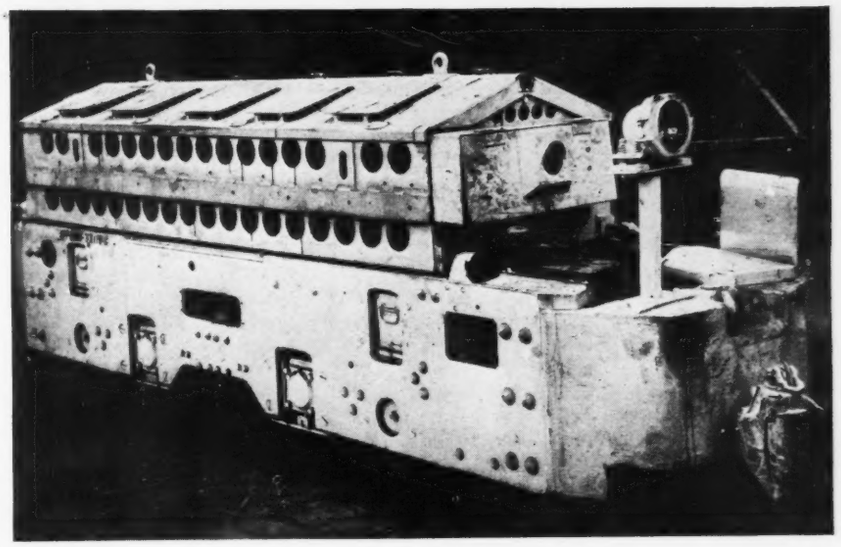


FIG. 7 . . STORAGE-BATTERY LOCOMOTIVES serve the Butte mines for underground haulage purposes. This 7-ton, 18-in. gage unit is of the type used on all important levels

motors are sealed and have self-contained fans for circulating air through their windings and a fin-type surface cooler. The latter is inclosed in a tight compartment on one side of the motor, from which the heat is absorbed by water, which, after circulating through the cooler, is discharged to the pumps and lifted out of the mines. These motors, which are of the induction type, are rated at 250 hp., and have magnetic control, which in sequence starts or stops pumping by the movement of a float switch in a sump.

For reasons of both safety and economy, all tramming underground is done by storage-battery locomotives. Fig. 7 shows the type of unit used on all of the important levels in the Butte mines. On the older mine levels, which were developed at the time of animal haulage and now require only a small amount of tramming, a locomotive weighing about 1½ tons, and which can be transferred from one level to another, is performing the service satisfactorily. To economize as much as possible in battery power, the larger locomotives have series-parallel control and to prevent accidents are provided with auxiliary contacts and a foot switch, so it is necessary for the motorman to sit in the locomotive before starting. A well-ventilated turreted compartment contains the alkaline storage batteries, which are charged at 250 volts at the end of their shift and at a time of off-peak power.

Inasmuch as all of the locomotives are equipped with ampere-hour meters arranged to open the circuit when the batteries are charged and by the use of a dead-front charging panel requiring no adjustment of charging current, it follows that the operation of connecting the locomotive to the charging circuit is simple and may be accomplished by the motorman. On account of the scattered zones in which about 250 locomotives operate, economical charging is important. It has been found that a motor-generator set rated at 75 kw. and operated from the 2,200-volt power circuits is the most economical unit that can be employed for charging purposes.

In general, motors in the mines rated above 30 hp. are operated at 2,200 volts, whereas the smaller motors driving portable fans or mucking machines are serviced at 440 volts. To lower fire risks at load centers, underground oil insulated transformers are gradually being replaced by others which use a non-inflammable fluid for cooling. Because portable electrical apparatus, if not properly grounded, creates additional hazards, safety from electrical shock is provided by incorporating in cables servicing such equipment a fourth conductor connected to the frames of such machines and substantially grounded at convenient points. Finally, in the application of portable cords or trail cables, there is a tendency on long runs to use sizes which will not permit sufficient power to flow so as to interrupt the circuits instantaneously in the event of insulation failure near the apparatus. As a consequence good practice dictates that cables for portable apparatus should have, aside from the fourth wire, conductors of liberal size.

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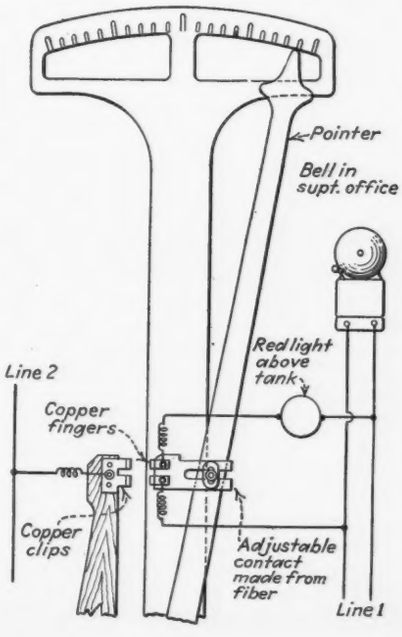
A Simple Overload Alarm

THOUGH the use of an electric overload alarm on continuous thickeners is rather a conventional matter at the average cyanide plant or mill, the type and design of the circuit and appurtenant parts vary considerably. Usually such a device consists of a switch arrangement on the pointer attached to the drive mechanism of the thickener shaft, which closes the circuit and rings an alarm bell or lights a colored lamp when the thickener load is excessive. The layout used by Frank J. Krazel, chief electrician at the property of the South American Development Company at Portovelo, Ecuador, S. A., and explained in detail in the accompanying sketch, will be found particularly useful at plants remotely situated and where only unskilled labor is available. The device is of simple design and inexpensive to manufacture, and consists of a slotted fiber contact with two copper switch fingers bolted to the pointer, and the corresponding copper clips attached to a stationary holder made from wood. On the occasion of an overload, the pointer moves gradually over to the left until the copper fingers on the fiber contact piece reach the copper clips on the wooden holder, which closes the electric circuit and simultaneously lights the red lamp above the thickener and rings the alarm bell in the superintendent's office.



A Modern Hospital Serves Climax Camp

This high-altitude mining community is well equipped against pneumonia as well as other evil possibilities

J. K. Richardson
Safety Director
Climax Molybdenum Company
Climax, Colo.

PUBLIC RELATIONS for THE MINING INDUSTRY

THE PROPERTY of the Climax Molybdenum Company, the source of 70 per cent of the world's supply of molybdenum, is on Bartlett Mountain, in Lake County, Colo. Climax, the company's camp, is on the western slope of the mountain and 13 miles north of the famous mining town of Leadville. Camp and plant are directly east of the summit of Fremont Pass, whose altitude is 11,320 ft. Ordinarily, road conditions during the winter months are poor, due to heavy snowfall and consequent snowslides. In these months practically all traffic is directed toward Leadville, for the road is kept open by snowplows as well as possible.

An attempt has been made by the Climax company to provide excellent housing and recreational and welfare facilities. In keeping with this policy, a strictly modern hospital and medical department have been provided, so that a high standard of health can be maintained among employees and their families. At present only about 60 per cent of the employees are living at Climax. The rest, mostly married, live in Leadville.

The present camp consists of 185 three-, four-, five-, and six-room houses, most of them for a single family, although some are duplex, accommodating two families. Occupying these dwellings are department heads, supervisors, and senior employees. A hotel is operated by the company for single employees. During the past year this has been enlarged to house approximately 525 single men. An annex has been built which, in an emergency, will accommodate 100 additional men. The main hotel is built of brick and tile, and men are housed two in a room. The buildings are steam-heated and have the latest washroom and toilet facilities. The population of the camp is about 1,200.

The company has maintained a hospital at Climax since the start of operations. Recently a new one has been provided. The old hospital was primarily a first-aid and emergency station. All operative, serious cases, arising from accident or illness, had to be removed to Leadville. Sometimes, however, road conditions were such that movement of traffic was virtually impossible, and inasmuch as the policy of the company has been to spare no expense if a life were to be saved, a new hospital was included in the construction plans for 1936. This is situated some 200 yards south of the mine portal, such location making it easily accessible to the mine if a serious accident occurs underground. The building has a single story and its architecture conforms to the general scheme of the other industrial and office buildings of the camp. It is so arranged that room can be added as the need increases.

The floor plan provides a reception room, a doctor's office, an examining room, a drug room, two wards, a kitchen, a nurses' room, an X-ray laboratory and developing room, an operating and "scrub-up" room, and two private rooms. Rooms and wards are equipped with connecting baths and toilets. The building is heated by a central plant, which also serves general offices and mine change room.

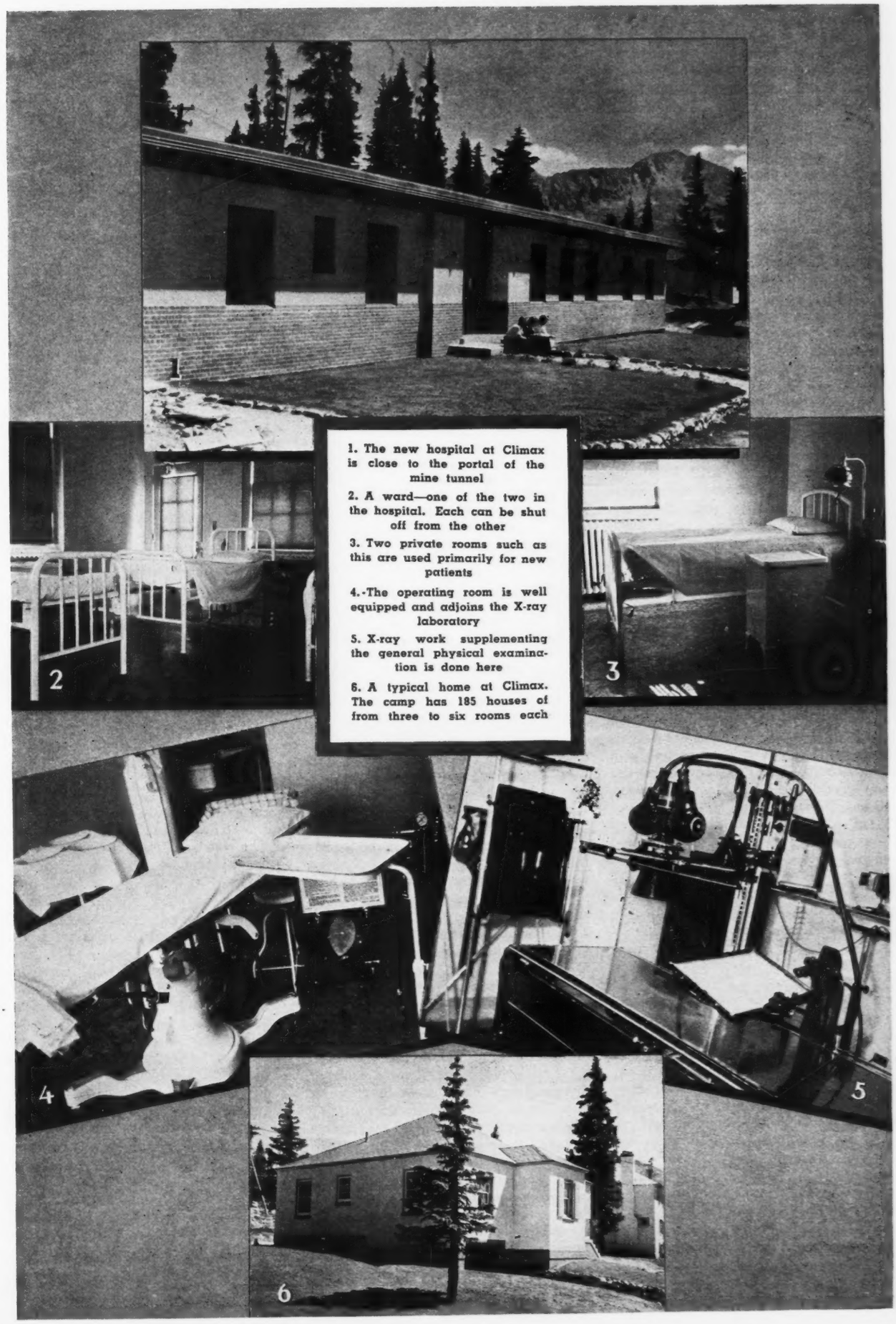
The doctor's office adjoins the drug and examining room. A medical examination is made of all new employees before they are hired. Here, also, are provided a consultation service for active employees and their families; likewise free physical examinations for new men and employees actively engaged. By examining every one periodically we are better able to care for the health of the community.

Available to all employees, and included in their hospital fee, are any drugs which may be needed for treatment of minor ailments or injuries. The drug room is directly off the reception room. Here, also, are dispensed materials needed for depleted first-aid kits.

Supplementing the general physical examination, we are also equipped for X-ray work with the latest 100 milliampere equipment. This is made by General Electric and is such that photographs can be taken of any part of the body. The table used is of the tilting type, so that we can treat a person and at the same time take pictures from any angle. Fluoroscope equipment is also included, allowing us to make preliminary studies of the patient and to view the result of the work later. In connection with the other equipment we are able to take stereoscopic pictures which allow a close and detailed study of the various parts of the anatomy. The control and developing rooms adjoining the laboratory are lined with sheet lead and the windows opening from them into the laboratory are impregnated with lead to prevent rays from filtering through. Thus the technicians as well as the film are given complete protection from the rays. All pictures are filed for reference. A complete history is kept for each employee.

The operating room is directly off the X-ray laboratory. Between the two is a "scrub-up" room, where the staff may prepare for such operations as they are called on to perform. In a small alcove a modern water filter and sterilizer is provided. Here, also, is kept the instrument case, where it is easily accessible to the sterilizing apparatus. The operating table itself is of the very latest design, with arm and leg supports, hydraulic lift, and locking wheels. An eight-bulb operating lamp, casting no shadows that might interfere with the operating work, is directly above the table. The lamp light is supplemented by that from a window stretching along the entire north wall of the operating room. As emergency equipment, a lamp having wet-cell batteries that can be used if the regular power should fail is provided.

As an emergency source of oxygen, we use the E. & J. resuscitator. This apparatus can be used on "gassed"



1. The new hospital at Climax is close to the portal of the mine tunnel

2. A ward—one of the two in the hospital. Each can be shut off from the other

3. Two private rooms such as this are used primarily for new patients

4. The operating room is well equipped and adjoins the X-ray laboratory

5. X-ray work supplementing the general physical examination is done here

6. A typical home at Climax. The camp has 185 houses of from three to six rooms each

patients or whenever an increased oxygen supply is needed by a patient. It works on the principle that makes it impossible to give a patient more oxygen than his lungs can accommodate—a distinct advantage over the pulmotor of the old type. The apparatus also facilitates artificial respiration.

Our success in operations has been exceptionally good, despite the fact that there have been some unusually complex cases. This is doubtless due to the skill of the staff, supplemented by the excellent equipment in the operating room. The room and its equipment were designed by a surgeon.

Directly opposite the operating room on the west side of the hospital are two private rooms joined by a connecting bathroom. These rooms are modern in every respect, having the latest kind of beds and hardware. They are used primarily for new patients prior to sending them to the ward for treatment; also by the wives and children of employees.

The two wards lie on the south end of the building and, like the private rooms, are equipped with the most modern of hospital beds and hardware. Toilet facilities are placed so that one ward can be shut off from the other and used exclusively for isolation cases. Between the two wards is a small clean-up room with a modern bed-pan sterilizer and a sink.

A modern kitchen is maintained on the east side of the structure. This connects with the nurses' room, which is equipped with a private bath.

The residence of the chief surgeon is approximately 75 ft. south of the hospital, to which it is connected by a lighted tunnel, so that the physician may readily be available at all times.

The "Hospital and Medical Service Plan" approved by the Industrial Commission provides that each employee living at Climax shall pay $1.50 per month and those employees outside the camp $1.25 per month. Each employee is thereby entitled to such medical or surgical attention as is necessary so long as the cost does not exceed $165 or six weeks' duration for any one illness. The fees charged are based upon the medical and surgical fee schedule published by the Industrial Commission. In industrial accident cases we will furnish treatment the cost of which does not exceed $665 or five months' duration. This is well in excess of that required by the Workmen's Compensation Law.

It has been necessary for us to refuse confinement cases, due to the limited facilities. These cases are normally referred to the Leadville hospital or to Denver. Contagious diseases are generally sent to a "pest house." This is done only where segregation is impossible in the hospital.

Pneumonia is perhaps one of the worst enemies a community living in high altitudes can have, but by use of a short-wave diathermy and serum treatment we have not lost a pneumonia case. This success has inspired the entire group with confidence that this menace to the health of the community can be overcome.

Our success in medicine and surgery is probably due, in part, to the fact that we are in a position to get the patient at the outset of the ailment. However, the major part of the credit goes to the excellent care received by the patient at the hands of the medical department.

We realize fully that health and efficiency go hand in hand, and by continuing to maintain our present standards we are daily bolstering the morale of the entire employee group.

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Leaded Grease Increases Life Of Dredge Parts

SEVERAL gold dredging companies operating placer dredges in northern and central California have found the use of powdered lead in bearing greases most beneficial in prolonging the life of dredge parts working under water and exposed to slime and sand. The lower tumbler bearings in particular are subject to rapid wear. To test the relative merits of the new grease compound, the Yreka Gold Dredging Company recently conducted a series of lengthy experiments on the 6-cu.ft. dredge exploiting a placer property near the city of Yraka.

The test on the lower tumbler bearings was conducted in the following manner: All bearings were carefully calipered and the dredge was run for 53 days with regular grease in the port bearings and leaded grease in the starboard bearings. The dredge then was shut down and the bearings were removed and re-calipered. Wear on the port side was 13/32 in., and on the starboard side 6/32 in.

In contrast of the port side, where the usual scoring and sand were found, examination of the starboard side bearings and shafts showed no scoring and the presence of only a small amount of fine slime. As to consumption of lubricants, 1⅓ drums of regular grease were used on the port side, and about 7/12 of a drum of leaded grease, or one third less, was used on the starboard side. Apart from this saving of grease, the field manager of the dredging company estimated that the life of the bearings was increased from 60 to 150 days. The powdered lead was supplied by the Metalead Products Corporation.

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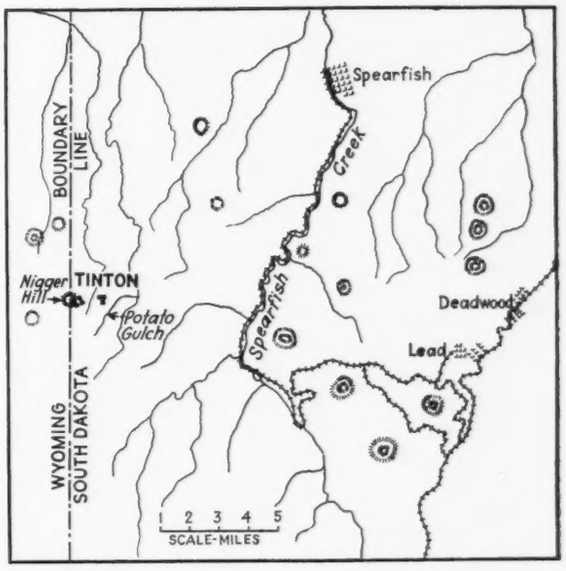
Chlorinating Ferruginous Bauxites

LITTLE or no application is made of the high-iron bauxites, abundant in many parts of the world; this is largely due to lack of a cheap method of separating the aluminum oxide from the iron oxide in the ore, according to Colin G. Fink and V. S. deMarchi, in a paper presented at the meeting of the Electrochemical Society at Rochester, N. Y., Oct. 12-15. This situation directed their study particularly to the low-grade bauxites of Istria, Italy. Of the various methods of beneficiation, those based on use of chlorine offered greatest promise, so the first experiments involved use of this reagent. In the preliminary work, they found why earlier attempts by others in using chlorine had failed, and, in turn, their experiments led to discovery that efficient, relatively simple separation of alumina from iron oxide can be made under commercial conditions if, as a preliminary, the iron is selectively converted to sulphide. Specifically, results show that: (1) Chlorination of Istrian bauxite with chlorine alone is not to be recommended, since the reaction is too slow, and the temperature required relatively high. (2) Chlorination with a mixture of chlorine and sulphur chloride is not practical, because other oxides present are converted into chlorides, with varying degrees of reactivity. Furthermore, by the sulphur monochloride-chlorine process, fractional separation of aluminum chloride from other chlorides is costly and impractical. (3) Chlorination of Istrian bauxite with a mixture of chlorine and hydrogen sulphide is not practical, because nearly all the aluminum is carried away with the other metal chlorides. (4) If the iron oxide is first converted into the sulphide and then chlorinated, 90 per cent of the iron oxide present, over 50 per cent of the TiO_2, and about 14 per cent of the SiO_2 present will be eliminated as chlorides, carrying along about 9 per cent of the original alumina. (5) The well-defined temperature range, within which chlorination of sulphided bauxites is possible, within practical limits. (6) There are well-defined practical limits for duration and speed of chlorination, and for the particle size of sulphided Istrian bauxite.

Tantalum From the Black Hills

The deposits of South Dakota provide the only commercial domestic source at present

Arthur I. Johnson
Consulting Engineer
Fansteel Mining Corporation
Tinton, S. D.



MINING OPERATIONS in the Tinton district, in the Black Hills of South Dakota, can be traced back to the gold rush of 1875, when the excitement in the Deadwood section spread to neighboring areas. The discovery of placer gold in Iron Creek led to the exploration of areas leading into this stream, resulting in the opening of rich gold placers in Nigger Gulch, Bear Gulch, Mallory Gulch, and Potato Creek. According to Headden, it was in the placer gold from this district, in 1876, that cassiterite was first identified in the Black Hills by Richard Pearce. In the operation of the placers, a considerable amount of tin concentrates was produced and shipped to England. Exploitation of the best tin claims resulted in the development of other mineral resources, especially the rare metals tantalum and columbium, with which this paper deals.

The Metal Tantalum—Progress during the past twenty years in the isolating and commercializing of many of the less familiar elements has brought to mankind many new metals. Some of these are yet in the development stage, but others have moved forward rapidly into important fields of scientific and industrial use. In the latter class is tantalum.

Noted as an element and named by Ekeberg in 1803, tantalum was not produced in a metallic state until 1903, when von Bolton made lamp filament wire and small pieces of sheet which were used to a limited extent in dental and surgical instruments. In 1922 Dr. Clarence W. Balke, director of research of Fansteel Metallurgical Corporation, developed a practical process for producing tantalum on a commercial scale, which, with some modifications and improvements, is still in use.

In its pure state, tantalum is characterized by its great resistance to acid corrosion, its strong affinity for oxygen and other gases at elevated temperatures, its very low coefficient of thermal expansion, and its extremely high melting point. It has another useful property of being an electrolytic "valve"—placed in an electrolyte with a dissimilar metal, it rectifies alternating current.

These properties have made tantalum an important material of construction in the chemical industries, especially in heat-transfer operations where corrosion or contamination must be avoided. The use of tantalum equipment has made possible the commercial development of many important new chemical products, and has substantially lowered the production cost of staple chemicals such as hydrochloric acid.

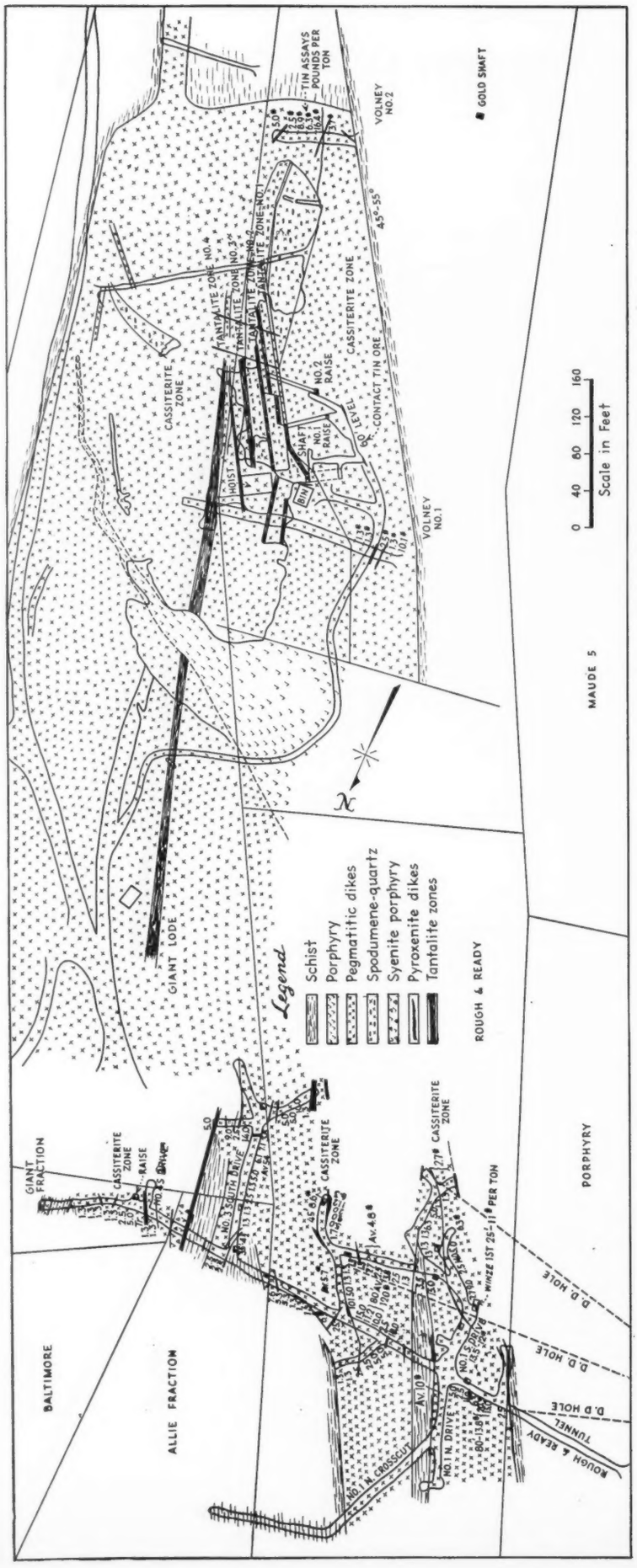
Tantalum's affinity for gases, its low thermal expansion, and its high melting point have made it a recognized superior material for anodes and grids in several types of electronic tubes, notably the tubes used in ultra-high-frequency radio transmission and radio therapy. Heated by the operation of the tube, the tantalum elements absorb stray gases left by the vacuum pump or liberated by the other materials in the tube, thus maintaining the high vacuum necessary for efficient operation.

The electrolytic "valve" property of tantalum is the basis of the famous Balkite rectifier, thousands of which are used to charge batteries for railway signals, telephones, fire alarms and burglar alarms.

The most important tantalum compound is the carbide, which approaches the diamond in hardness. Though there are other hard carbides of refractory metals, tantalum carbide possesses, in addition to hardness, a unique property best described as self-lubrication. As a result, cutting tools of tantalum carbide resist chip wear and "cratering" which limits the use of most refractory carbides, especially in tools employed in the cutting of steel.

Tantalum Minerals—Tantalum is produced from the mineral tantalite, a tantalate of iron and manganese, which is usually associated with columbite ($Fe(CbO_3)_2$). The two minerals form an isomorphous series in which there is an almost complete gradation of one mineral into the other, neither being found entirely pure. Often associated with tantalite and columbite are small amounts of titanium, tin, or tungsten. The mineral usually occurs with cassiterite in placers, in which case it can be separated with a magnetic separator. Commercial extractions are considerably interfered with by ratios of columbium to tantalum, and the presence of titanium in excessive amounts makes the extraction extremely difficult.

The principal source of tantalite has been Western Australia, the Pilbarra field being the producing center. The Wodgina property has produced concentrates at the rate of 20 to 30



TANTALITE and CASSITERITE, found in the large pegmatite deposit on Nigger Hill at Tinton, S. D., occur in zones, as illustrated

tons a year from the alluvial material below the outcrop of pegmatite which carries the mineral. These concentrates are especially rich in tantalum, carrying an average of less than 10 per cent columbic oxide and 65 per cent Ta_2O_5.

Though the development of tin placers in Nigeria has brought about the production during the past few years of several hundred tons of columbite yearly, and recent reports indicate the Belgian Congo as a possible production center for tantalite and columbite ores, the deposits in South Dakota are the only commercially important sources of tantalum metal in the United States at present. Small lots, however, have come from New Mexico, Wyoming, and Colorado. It has also been reported from California, Connecticut, Maine, North Carolina, South Carolina, and Virginia, but production from all these sources has been minor in amount.

Table I, showing production of tantalite-columbite from South Dakota, makes no segregation of the amounts of the two minerals individually. Foreign imports taken from trade reports show amounts imported from 1918 to 1937 inclusive.

Table I—Source of Supplies of Tantalite and Columbite for the United States

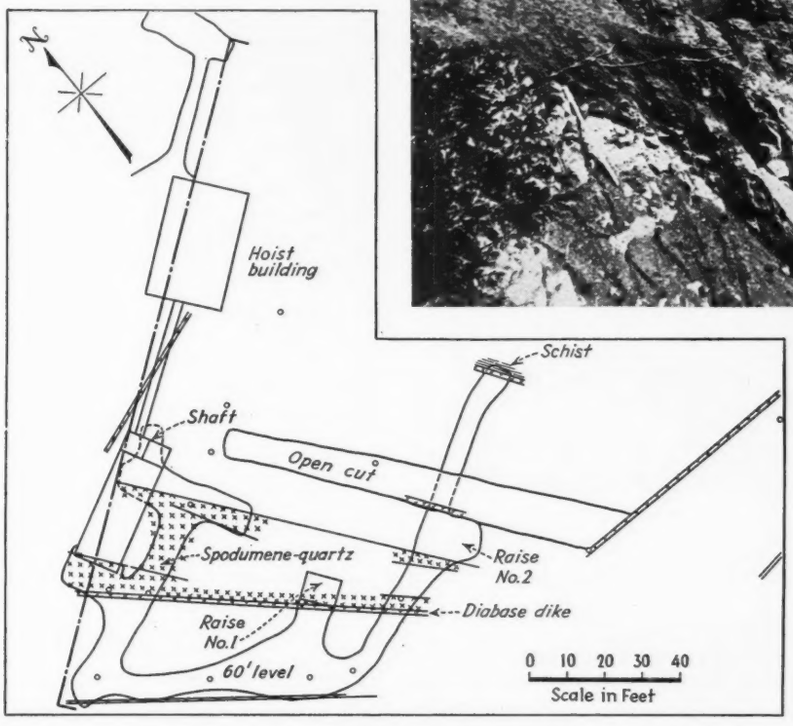
	Imports[1]		South Dakota Production[2]	
Year	Amount	Value	Amount	Value
1928	None	.....	4,500	$2,250
1919	None	.....	300	90
1920	Ta 60 lb. Fe-alloy	$54	4,000	1,450
1921	Ta 1,229 lb. Fe-alloy	788	3,400	1,150
	Ta 6,785 lb. Ta-ore	1,327	.....	.....
1922	None	.....	600	240
1923	5,600 lb. tantalite	3,031	1,350	540
1924	None	.....	1,197	598
1925	5,022 lb. tantalite	1,347	.....	.....
1926	350 lb. tantalite	149	2,100	650
1927	15,119 lb. tantalite	20,012	1,100	378
1928	None	.....	34,899	26,332
1929	15,250 lb. tantalite	19,418	22,117	17,261
1930	8,474 lb. tantalite	7,036	4,100	2,870
1931	6,288 lb. tantalite	6,289	300	210
1932	36,131 lb. tantalite	51,033	.....	.....
1933	14,257 lb. tantalite	20,530	.....	.....
1934	24,630 lb. tantalite	35,441	425	168
1935	6,083 lb. tantalite	9,342	7,681	4,521
	1,184,315 lb. columbite	97,737	7,900	5,530
1936	57 metric tons of columbite-tantalite ore — value, 40,000 francs, 20,758 lb. tantalite	30,751	[3] 7,000	4,550
1937	461 tons columbite	$306,086	([3])	.....
	20,897 lb. tantalite	40,742	[3] 13,000	11,100

[1] U. S. Bureau of Mines Statistics
[2] F. C. Lincoln: Black Hills *Engineer*, Jan., 1937.
[3] Estimated.

The columbium associated with tantalum is of relatively small importance so far as the production of columbium metal is concerned. Pure columbium was first produced by Fansteel in 1929, and has found commercial uses to a limited extent. Its characteristics are substantially the same as those of tantalum, although it resists corrosion to a somewhat lesser degree.

Its density is only half that of tantalum, and, although the pure metal is at present more valuable than tantalum on a basis of weight, its price on a basis of area or length is less than that of tantalum. Use of ferrocolumbium in stainless steels to prevent intergranular corrosion at a high temperature is well known. The chief source of supply for ferrocolumbium, however, is from the tin ores of Nigeria.

Columbite was first mentioned in the Black Hills in 1884 by W. P. Blake[3], who records it as having been found in the Etta and Bob Ingersoll mines, and describes a mass of more than 2,000 lb. in weight from the Ingersoll claim. Schaefer[4], in the same year, described tantalite in the Black Hills. W. P. Headden[5], in 1891, recorded analyses of tantalite from the Black Hills region. His Mallory Gulch and Nigger Hill samples are representative of the ore found in those districts.



EXTENT of present operations of the Fansteel Mining Corporation, at Tinton, S. D., is shown on this plat

Tantalite Production—In the Tinton district no actual interest in the production of tantalite was shown until 1927, when the possibilities became apparent while grading a road through the east side of the pegmatite dike which was later to become known as Tantalum Hill. At that time work was in progress on the construction of a 150-ton unit for milling tin ores from the Rough and Ready mine of the Black Hills Tin Company.

It might be well to explain here that the name "Nigger Hill" refers to the entire district. The operations of the Fansteel Mining Corporation are in the particular section designated as "Tantalum Hill," to distinguish it from the area containing the Rough and Ready workings, which are within the tin section of the dike.

Several tons of concentrates were produced during 1928 and 1929 which contained 38.7 to 57.0 per cent Ta_2O_5. Mining operations were carried on with a gasoline shovel in an open cut, the tantalite being sorted by hand.

Operations were discontinued in 1929, and no further work was done on Tantalum Hill until 1936, at which time amblygonite was discovered in the waste dumps from the tantalite operations. A further study proved amblygonite in place, and work was started in sorting the old dumps and mining sections of the deposit in place. Operations were continued by the Black Hills Tin Company during 1937 and 1938, and to date some 350 tons of amblygonite have been recovered. A study of the deposit has been made by Barnabas Bryan, Jr., and Frank L. Hess, principal mineralogist, United States Bureau of Mines, and their work has been incorporated in the United States Bureau of Mines Publication R.I. 3404, June, 1938.

In February, 1937, the property

OPEN CUT on the Rough and Ready or northern portion of the pegmatite dike. This is the cassiterite-bearing section of the dike.

was leased by Fansteel Mining Corporation, a wholly owned subsidiary of Fansteel Metallurgical Corporation. Work was started in April, 1937, to sink a shaft on Tantalum Hill to investigate the tantalite deposit at further depth and to provide means for mining the ore already exposed. Sorting chutes, hoisting equipment, and a storage bin of 125 tons' capacity were installed at the mine.

The shaft has been sunk to the 60-ft. level and the drift carried south, from which ore raises have been driven to the surface. Mining is done in an open pit, the ore being drawn through raises to the 60-ft. level and hoisted to the surface for sorting. A plat of the workings shows the general plan of operations. The zonal arrangement of the deposit was indicated from outcrops, which was substantiated by further work at the surface in open cuts while the shaft was being sunk. Operations have been carried out on the basis of these findings.

Milling Operations—Approximately half the tonnage mined is milled, the remainder being sorted out as waste. The mill flowsheet was designed to handle a mine production of 35 tons during a sixteen-hour period.

Ore is delivered to the mill in a 1½-ton Ford truck, which discharges its load into a bin hopper feeding a gyratory crusher, which breaks the ore to minus 1 in. The gyratory dis-

[3] W. P. Blake: *"Columbite in the Black Hills of Dakota."* *Amer. Journal Science*, 3d series, Vol. 27, Pp. 340–341.

[4] Charles A. Schaeffer: *"A Note on Tantalite and Other Minerals Accompanying the Tin Ore in the Black Hills."* A.I.M.E. *Trans.* Vol. 13.

[5] W. P. Headden: *"Columbite and Tantalite From the Black Hills of South Dakota."* *American Journal Science*, 3d series, Vol. 41, Pp. 89–102.

ON TANTALUM HILL (above), as the southern part of the pegmatite dike is known. Here the width of the dike is more than 400 ft. The buildings house the hoist, the sorting section, and the bins. Below, MILL and power plant operated by the Fansteel Mining Corporation. At present about 35 tons of tantalite-columbite ore is being concentrated in 16 hours daily

charge is fed to a No. 2 Symons cone crusher, the undersize from the minus-1-in. gyratory product being removed by a vibrating screen. The cone crusher has been set to produce a minus-½-in. material, which discharges directly into a surge bin, from which it is trammed to the tantalum mill bin. An automatic feeder discharges the ore from this bin to a bucket elevator in closed circuit with a triple-deck vibrating screen. The oversize is crushed by rolls and the undersize distributed to a series of bins for the several sized products. Three sizes, —8 +14, —14 +20 and —20 mesh, are treated separately on Deister Plat-O tables, the coarse product being treated on a roughing table and the —20-mesh product on a corrugated riffle slime table. Middlings are retreated and the rough concentrates dried screened into five sizes: —18, —18+20, —20+30, —30—64 and —64 mesh.

Each of these sizes is then cleaned to a final concentrate. Middlings from the cleaning tables are returned to the same circuit after drying. Fine sand is removed by hand from the final concentrates before they are sampled and shipped to North Chicago in 75-lb. bags.

Geology—The pegmatite dike designated to the south as Tantalum Hill and on the north as Rough and Ready is approximately 1,500 ft. long and over 400 ft. wide in the Tantalum Hill section. In the Rough and Ready workings, the total width is greater. The tantalite occurs in a series of zones or sheeting planes in the pegmatite body. The footwall of the dike strikes N. 30 deg. W. and dips southwest at 45 to 60 deg. The dike is intruded into an area of amphibolite schists which in sections on the hanging-wall side is mineralized with arsenopyrite and pyrite carrying gold. Development work is now being conducted to determine the extent of this mineralization.

Zoning of the tantalite is shown on the geological plan, the tantalite being closely associated with the spodumene-quartz mixture which makes up the core of the dike on Tantalum Hill. Zone No. 1 follows closely the hanging-wall side of this deposit. To the west of this zone and separating it from the cassiterite section of the dike is a width of 2½ to 4 ft. of soda feldspar carrying considerable quartz. The mica-quartz zone in which the cassiterite occurs on the hanging-wall side of the dike at Tantalum Hill is highly stained at the surface, and in the photograph of the open-cut section of Tantalum Hill, the stained area is plainly shown against the white of the dike. The other zones are shown as they occur on the surface level, the No. 4 zone being the only one which can be followed definitely into the vicinity of the Rough and Ready.

Tantalum Hill represents a highly altered section of the dike, the sequence of the deposition of which has been described by Hess and Bryan in Report of Investigations 3404, on the pegmatites occurring at Tinton, South Dakota.

Tantalite occurs in a number of the other dikes in the region, but not in sufficient quantity to warrant development for that mineral alone.

Table II—Record of Production of Tantalite Concentrates, Tinton District

Lode Mining

1928	Pounds	Tinton Pounds
Mine Production	17,263	17,263
Purchased from Southern Black Hills Mines	5,267	
	22,530	
1929		
Mine Production	8,962	8,962
Mar. 1937 to Aug. 1938		
Mine Production	17,279	17,279

Placer Operations

1937	Tinton Pounds
Tin and tantalum concentrates (tantalite, 3,457 lb.; tin, 6,329 lb., separated magnetically)	11,023

Table III—Average Operating Costs for Three-Month Period

	Per Ton
Mine costs	$1.129
Sorting cost	0.331
Trucking cost	0.186
Development cost	0.271
Milling cost	1.205
Superintendent and office	0.630
Miscellaneous	0.020
Total	$3.772

Milling Costs	Per Ton
Coarse crushing	$0.154
Fine crushing, tabling	0.252
Cleaning concentrates	0.122
Pumping	0.064
Repairs—replacements	0.329
Power	0.284
Total	$1.205

Differential Grinding

As an Aid in Ore Concentration

Experimental work gives promising results with oolitic iron ore and carnotite, both having constituent minerals differing greatly in hardness

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GRINDING is an essential part of most concentration processes, because the size of particles and to a smaller extent their shape are of major importance in determining the grade and recovery of the products. Little attention has been given to the fact that, by a judicious choice of the method of grinding, certain ores may be ground so that the grinding constitutes a step in the concentration practice, either by the direct production of concentrates or tailings or by preparation of the feed so that the concentrating methods that follow are more effective.

An ore in which the hardness of the constituent minerals differs considerably, particularly if the harder mineral occurs in the larger particles, offers possibilities for the beneficial use of differential grinding. Differential grinding is the grinding of the softer increment at a greater rate than the harder portion. With almost all forms of crushing and grinding there is some differential grinding, but under proper conditions it may be carried to the point where one mineral increment is effectively ground while the other remains virtually unaffected. The value of this form of grinding in the concentration of two ores will be considered.

Iron Ore—A low-cost, efficient method of concentrating the low-grade, siliceous, oölitic iron ores of Alabama has long been sought. Large tonnages containing too much silica for direct treatment in the blast furnace are known, and several investigators have attempted to solve the problem of their treatment. A successful method of concentration would greatly increase the country's iron-ore reserves.

Oölitic iron ores have a peculiar structure consisting essentially of nuclei that are usually quartz surrounded by concentric layers of hematite, siliceous and argillaceous material, and occasionally layers of calcite. Hematite and calcite cement the oölites together. There is no appreciable amount of clean hematite in sizes coarser than a few microns. The so-called hematite is an exceedingly fine-grained intergrowth of hematite and material having the approximate composition of kaolinite. The structure of the ore is shown in Fig. 1.

Previous investigators[1] have shown that the cleanest concentrates obtainable on minus 200-mesh ore will contain approximately 54 per cent of iron and 8 to 12 per cent of insoluble (silica and alumina). Concentrates of this grade are therefore the optimum that can be obtained at this size by ore-dressing methods. It is possible to reject the quartz which makes up the nuclei of the oölites, but the part of the gangue that appears to have been deposited in the form of kaolinite along with the hematite cannot be removed to any appreciable extent. The fact that the hematite is soft and the quartz oölites are hard seemed to offer distinct possibilities for the use of differential grinding as an aid in the concentration of these ores. Some years ago a method[2] was reported in which rubber-covered rods were employed to give a differential grind. Excellent results were obtained, but the rate of grinding was slow.

Ball-mill grinding tests[3] have shown that there is a definite size of grinding media best adapted for a given size and hardness. Larger balls are required to grind efficiently a hard mineral than one that is soft. As the size of grinding media is decreased, the grinding rate for a hard mineral, such as quartz, becomes smaller and smaller until a size is reached at which the grinding rates become nil for all practical purposes. Media of this size may, however, be large enough to grind a soft mineral rather effectively.

In May, 1937, a systematic study was undertaken by the ore-dressing section of the Metallurgical Division of the Bureau of Mines of various sizes and shapes of grinding media in a search for one that would give a differential grind of the oölitic iron ores. The ultimate aim was to grind the ores so that the minerals would be liberated to a degree that would permit table concentration and so that all of the slimes produced would be of concentrate grade without further concentration.

The ore chosen for laboratory work was from the Spaulding mine and was considered typical of a large tonnage of siliceous ore in the Birmingham district requiring concentration. The ore had the following analysis: Fe, 36.6 per cent; insol., 27.7; and CaO, 7.4. The quartz oölites ranged from 10 mesh down; most of them were in the 20- to 48-mesh size, with few finer than 100 mesh. The desired grinding medium was one that would be large enough to grind particles of hematite but too small to grind the quartz oölites. Small steel punchings or small balls served the purpose admirably. Small disk-shaped punchings were given preference because they are cheap and have a better surface-weight ratio than balls.

The effect of grinding with various media is shown in Table I. In each instance the feed was 6-mesh mine-crushed ore from which all the minus 100-mesh material had been removed. The primary fines, which were of concentrate grade (44 per cent Fe, 12 per cent insol., and 7 per cent CaO), were removed so that the nature of the fines made in grinding could be studied to greater advantage. The samples were ground to give approximately the same quantity of slimes. It may be noted that the 1.5-in. rods and 2-in. balls gave little differential grinding, and that the minus 100-mesh portion contained from 23 to 25 per cent of insoluble. As smaller media were used the grade of the slimes improved. When ¼-in. punchings were used the slimes contained only 11.5 per cent insoluble.

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[1] W. H. Coghill: "Degree of Liberation of Minerals in the Alabama Low-Grade Red Iron Ores After Grinding." *Trans.* A.I.M.E., vol. 75, 1927, pp. 147–165.

Oscar Lee, B. W. Gandrud, and F. D. DeVaney: "Magnetic Concentration of Iron Ores of Alabama." Bull. 278, Bureau of Mines, 1927, pp. 75.

[2] F. D. DeVaney, B. W. Gandrud, and W. H. Coghill: "Gravity Concentration of Alabama Oölitic Iron Ores." R. I. 2937, Bureau of Mines, 1929, pp. 7.

[3] W. H. Coghill, and F. D. DeVaney: "Ball-Mill Grinding." T. P. 581, Bureau of Mines, 1937, pp. 44–49.

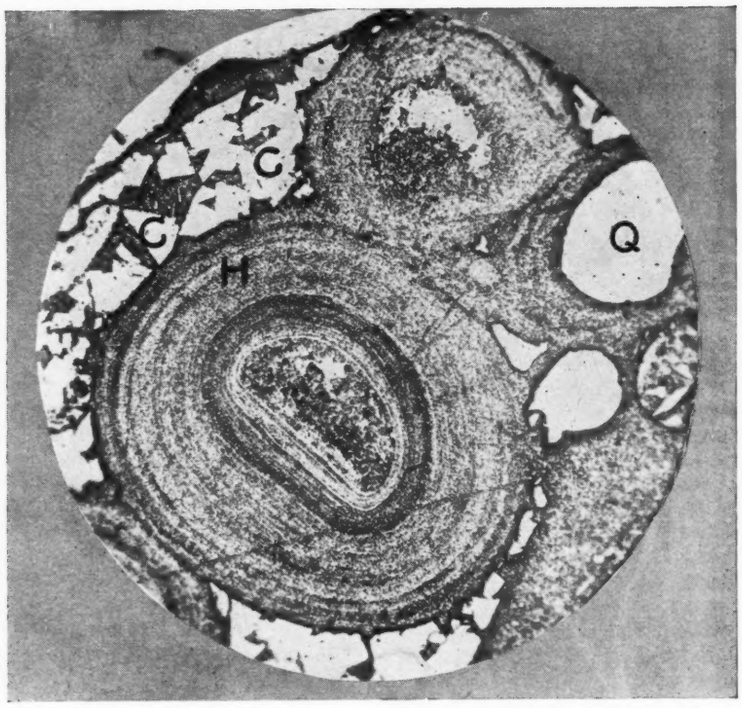


Fig. 1 . . . OOLITIC HEMATITE ORE, Birmingham district. *H*, hematite; *C*, calcite; Q, quartz. Polished section, X60. S. R. B. Cooke: "Microscopic Structure and Concentratability of the Important Iron Ores of the United States." Bul. 391, U. S. Bureau of Mines, 1936, p. 106

This insoluble content is near the minimum that can be expected and indicates that practically none of the quartz oölites were ground to slimes.

Table I also gives the weight, surface, and weight-surface ratios for each grinding medium used. The figures show that the differential scuffing action is best when the ratio between the weight and surface is low. However, the ratios do not tell the whole story. In rod grinding the entire weight of the rod may be concentrated on only a few particles that are caught between adjacent rods. In grinding with balls the contact between the balls is essentially between points, and the entire weight may be concentrated on a single particle. However, with the punchings the contact between adjacent disks is usually a plane-to-plane contact, and the weight or crushing force may be taken up by a large number of particles. This is probably why the punchings gave better differential grinding than balls of equal weight; for example, $\frac{3}{8}$-in. punchings which weighed 1.95 grams gave a better differential grinding than $\frac{1}{4}$-in. balls which weighed only 1.11 grams.

In this type of grinding the action of the punchings or small balls is distinctive. To describe the rubbing action, the term "scuffing" has been adopted. The media are large enough to break away the cementing material from the oölites but too small to crush the oölites. The action of the small media is to rub or scuff off the layers of iron oxide, leaving the polished quartz grains uncrushed.

In the operation under consideration, the quartz oölites remain unground even though the grinding is continued for a period longer than necessary to scuff the hematite. As shown in Table II, grinding was continued until about half the ore had been ground to pass 100 mesh, and with this severe grind the percentage of insoluble in the slimes did not increase appreciably. As the severity of the grind increased, the slimes became lower in iron owing to the grinding of more of the calcareous increment, which has a hardness greater than that of the hematite but considerably less than that of the quartz. It may be noted that the time of grinding can be extended to the point where the oversize is of tailings grade.

In the "scuffing" tests the ore was stage-crushed in rolls to pass 8 mesh, after which it was deslimed, classified, and tabled. Primary slimes produced in this manner are of concentrate grade, as very few of the quartz oölites are shattered at this size. The granular part of the ore was tabled after classification, and concentrates only were removed. The remainder was then sent to the ball mill and scuffed with $\frac{1}{4}$-in. punchings, after which it was classified and tabled, giving concentrates, middlings, and tailings. Middlings were returned to the scuffing mill. It is impossible to make low-grade tailings from the original ore, owing to the layers of iron oxide surrounding the quartz nuclei. This is why concentrates only were made

Table I—Differential Grinding of Oolitic Iron Ore With Various Types of Grinding Media

		Weight, Per Cent							
		Discharge After Grinding With:							
Size, Mesh	Feed	1.5-in. Rods	2-in. Balls	1 + ⅜-in. Empty Pipes	½-in. Balls	⅜-in. Balls	¼-in. Balls	⅜ × ⅛-in. Punchings	¼ × ⅜-in. Punchings
8	5.2	.....	0.2	.....	2.7	1.7	2.6	2.6	2.1
10	8.9	.....	0.4	.....	5.2	5.2	5.9	5.0	4.8
14	12.6	0.6	1.2	.....	7.1	7.8	9.5	7.9	8.0
20	15.9	1.2	5.7	0.4	9.9	11.0	12.6	11.8	11.8
28	15.6	5.3	15.4	5.5	9.6	11.4	13.0	11.6	11.9
35	16.1	18.3	21.8	22.8	12.2	11.4	12.0	14.6	13.7
48	12.1	23.2	17.5	21.3	10.4	9.1	9.0	10.8	10.2
65	8.1	17.9	12.5	16.8	8.7	6.6	5.5	7.2	6.3
100	5.5	11.3	8.1	9.9	7.1	5.5	3.9	5.1	3.6
−100	.....	22.2	17.2	23.3	27.1	30.3	26.0	23.4	27.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				ANALYSES					
−100 Fe	.....	38.96	38.63	39.20	42.56	43.78	44.34	44.50	45.76
−100 Insol.	.....	25.32	23.36	21.40	13.92	14.08	13.68	12.10	11.52
−100 CaO	.....	6.86	8.26	7.56	8.85	7.25	7.19	9.32	8.13
+100 Fe	31.52	29.14	30.05	29.18	27.39	26.18	27.01	27.55	26.09
+100 Insol.	32.10	33.86	33.91	35.34	38.86	39.92	38.57	38.21	39.94
+100 CaO	9.23	9.86	9.43	9.74	9.36	10.08	9.95	9.20	9.65
Weight of media, grams		2,090	521	595	5.50	2.18	1.11	1.95	0.72
Surface (sq. cm.)		368	80.9	289.4	3.88	1.97	1.26	2.37	1.11
Ratio $\frac{\text{Weight (gm.)}}{\text{surface (cm.)}}$		5.66	6.43	2.05	1.41	1.10	0.88	0.82	0.65

Table II — Effect of Prolonged Grinding of Oolitic Iron Ore Using ¼-in. Punchings

		Weight, Per Cent		
		Length of Grind		
Size, Mesh	Feed	3 Minutes	9 Minutes	18 Minutes
8	5.2	2.4	1.8	1.7
10	8.9	4.8	4.8	4.5
14	12.6	8.0	7.9	7.2
20	15.9	12.6	11.2	10.3
28	15.6	13.1	10.7	8.5
35	16.1	15.9	11.4	10.1
48	12.1	13.0	7.5	5.3
65	8.1	8.7	3.8	2.5
100	5.5	5.0	2.2	1.5
−100	.....	16.5	38.7	48.4
	100.0	100.0	100.0	100.0
		Analyses		
−100 Fe	.....	46.26	45.25	44.60
−100 Insol.	.....	11.28	11.76	12.18
−100 CaO	.....	6.72	9.54	10.24
+100 Fe	31.52	28.61	22.85	19.19
+100 Insol.	32.10	36.21	44.94	50.77
+100 CaO	9.23	9.72	9.04	8.27

in the primary circuit and tailings were not removed until after the material had been thoroughly scuffed.

To obtain the maximum quantity of hematite in granular concentrates, two classification and tabling circuits would be required in plant practice. However, concentrates of equal grade could be made if the entire granular portion were scuffed before tabling. A somewhat higher percentage of the hematite would be recovered as slimes and a lower percentage as table concentrates, but the over-all recovery would be about the same. This method would require only a single classification and tabling circuit.

The classifier slimes were minus 100 mesh and of concentrate grade. The scuffing action of the punchings left the round quartz nuclei of the oölites as uncrushed polished grains from which the iron oxide had been rubbed off and which were readily rejected by tabling. A condensed summary of the final products of the concentration of differentially ground ore is given in Table III, where it may be noted that 82.5 per cent of the iron was recovered in concentrates assaying 48.7 per cent Fe, 12.5 per cent insol., and 5.2 per cent CaO. Of the concentrates, 42 per cent was recovered by tables and the remainder as slimes.

If concentrates of similar grade were to be made by magnetic concentration of roasted ore, it would be necessary, if crushing were done in the usual way, to crush the ore to 100 mesh, because with the usual crushing methods the oölites are crushed and fragments produced that contain part of the central quartz particles and the layers of iron oxide which surround it. By scuffing, the quartz nuclei are not broken and may be removed at sizes as coarse as 10 mesh.

Fig. 2 is a photograph of the uncrushed ore, table tailings, and table concentrates. The characteristic oölitic structure of the ore, the rounded quartz grains in the tailings, and the rather tabular nature of the table concentrates are pictured.

If classified ores crushed in the usual manner are tabled, the slimes will be high in silica and must be concentrated. If the scuffing principle is applied, the ore cannot be overground, because the quartz grains will not be reduced after the iron oxides have been scuffed from the nuclei. This means that the grinding circuit does not require careful balance and regulation. If the grinding media are of the proper size, the insoluble content of the slimes will be sufficiently low no matter how severe the grind.

The grinding rate and power consumption of the punchings were measured in a 19x36-in. mill. When the ore was ground so that 32 per cent was finer than 65 mesh, it was found that the number of surface tons per horsepower-hour was 49. This compared with an average of 22 obtained when grinding Tri-State chert and 66 when grinding Southeast Missouri dolomite with 2½- to 1-in. balls. It may therefore be stated definitely that the grinding rate with punchings will be of the same order as that of a ball mill using the customary ball sizes in grinding an ore of average hardness.

Table III—Concentration Test of Differentially Ground Oolitic Iron Ore

Product	Weight, Per Cent	Assay, Per Cent			Per Cent of Total		
		Fe	Insol.	CaO	Fe	Insol.	CaO
Table concentrates	26.15	48.49	13.58	4.39	34.6	12.8	15.5
Slimes	35.89	48.86	11.80	5.79	47.9	15.3	28.1
Composite concentrates	62.04	48.70	12.53	5.20	82.5	28.1	43.6
Table tailings	37.96	16.85	52.48	11.02	17.5	71.9	56.4
Total	100.00	36.62	27.70	7.41	100.0	100.0	100.0

The test mill was provided with a regulation-type trunnion discharge, and with a mill feed of 8 mesh there was no tendency for the small (¼-in.) punchings to be discharged from the mill with the ground ore. The common phenomenon of small balls being crowded out of a mill is not due to the inherent qualities of a particular size, but the size of ejection depends on the ratio of the diameter of the largest balls in the mill to that of the smallest.

Carnotite Ore—A second example of an ore that responded to differential grinding was a carnotite ore from Colorado. This ore comprised quartz sand grains cemented together by earthy carnotite and clayey material Roscoelite containing vanadium, uranium, and radium is present in micaceous friable aggregates. Limonite occurs in the clayey material and as a stain on the sand grains. The sand grains, which range in size from 48 to 270 mesh, are also coated with carnotite. This ore contains 2.98 per cent V_2O_5, 1.08 per cent U_3O_8 and 2.82 mg. per ton of radium.

With small punchings it was possible to scuff off the coating of carnotite from the quartz grains and to break up the friable aggregates of roscoelite and the clayey cementing material, giving a slime product considerably enriched in the valuable constituents. This method gave concentrates containing 83 per cent of the vanadium in the form of a slime product containing 8.3 per cent V_2O_5. Vanadium, uranium, and radium are intimately associated in the ore as constituents of the same mineral. Analyses were not made for uranium and radium, as they were concentrated to the same degree. The screen analysis of the differentially ground carnotite ore is shown in Table IV. Examination of the minus 325-mesh increment showed that practically no quartz was crushed and that the gangue was clay.

Table IV—Screen Analysis of a Scuffed Carnotite-Vanadium Ore

Size, Mesh	Weight, Per Cent	Assay, Per Cent V_2O_5	Per Cent of total V_2O_5
−10+48	3.2	0.80	0.9
−48+100	24.5	.30	2.5
−100+200	32.3	.76	8.1
−200+325	10.1	1.73	5.8
−325	29.9	8.26	82.7
Total	100.0	2.99	100.0

As the carnotite ore occurs in a region where water is scarce, it should be possible to effect a 3 to 1 concentration, with a good recovery at the mine, simply by grinding the ore dry in a ball mill loaded with small media and recovering the carnotite and vanadium as fines with an air separator.

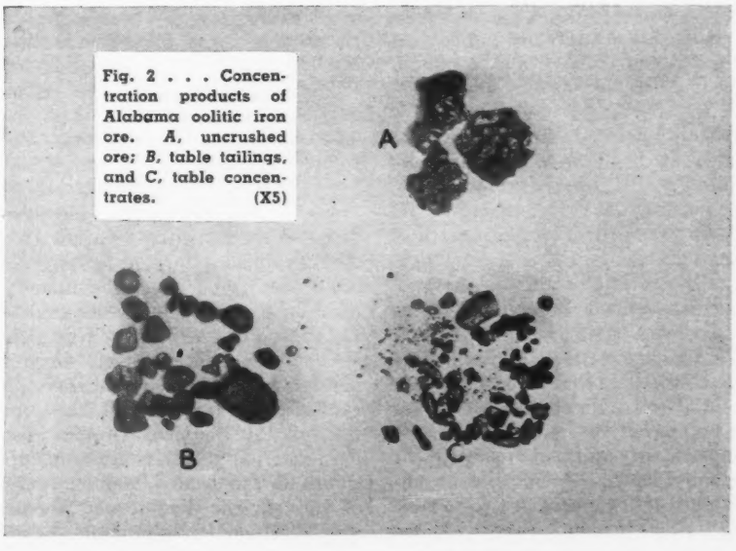


Fig. 2 . . . Concentration products of Alabama oolitic iron ore. *A*, uncrushed ore; *B*, table tailings, and *C*, table concentrates. (X5)

Chemical and Fertilizer Manufacture at Trail

Byproducts now figure importantly in operations of Consolidated Mining & Smelting Company

John B. Huttl
Assistant Editor

DURING the last ten years the production of byproducts at the reduction works of the Consolidated Mining & Smelting Company of Canada, at Trail, B. C., has increased to the point where it is now practically as large an undertaking as that of the combined lead and zinc smelters described previously. At the smelter itself and on Warfield Flat, about a mile away, is located what is considered one of Canada's largest chemical enterprises. The two factors responsible for this impressive development are: (1) the abundance of sulphur in the form of sulphur dioxide in the smelter gases; and (2) cheap electric power.

The fertilizer plant was comp'eted in 1931. It covers 60 acres, employs 560 men, and uses about 67,000 hp. of electrical energy. The principal plant units besides the sulphuric acid and sulphur dioxide concentration and reduction plants on the smelter site are the electrolytic hydrogen plant; ammonia plant; phosphate plant; ammonium sulphate plant; storage and shipping plant; repair shops; warehouse; laboratories, analytical and research; change room to accommodate 500 men; and general office. All buildings are of steel-and-brick construction. Steam for various plant operations is obtained from the waste-heat boilers at the slag-fuming plant through a 12-in. welded and heavily insulated pipe line. Raw phosphate rock is imported from Montana. Of a total expenditure of some $14,000,000, about $10,000,000 was spent on the original construction of the plants, and nearly $4,000,000 on subsequent additions.

The major part of the sulphuric acid produced at Trail is made from sulphur dioxide gas resulting from burning or roasting zinc concentrates. All plants employ the contact process and a vanadium mass. The gas, which leaves the Cottrell treater at the zinc smelter at about 300 deg. F., passes successively through lead-lined cooling and scrubbing towers, water wash towers of similar construction, and a second Cottrell unit of special design, where sulphuric acid mist and catalyst poison are precipitated. Subsequent treatment includes drying by scrubbing with sulphuric acid in two towers, and filtering through coke for the removal of entrained acid. Next, the clean dry gas goes through a heat exchanger to a converter containing the catalyst, where sulphur dioxide is oxidized to sulphur trioxide, after which it is repassed through the heat exchanger and then to coolers and absorbers where the sulphur trioxide is absorbed in strong sulphuric acid. This is followed by dilution with water to required strength for storage. As built, the plants have a combined capacity of about 415 tons of 100 per cent sulphuric acid per day. Gas obtained from the roasters at the zinc smelter contains about 6 per cent sulphur dioxide.

The sulphur dioxide plants at Trail are the result of considerable research and experimentation first started in 1929. The first commercial unit for the production of elemental sulphur was placed in operation in the summer of 1936. As practiced the process involves three main operations—namely, absorption of the sulphur dioxide, liberation of the sulphur dioxide gas from the absorbent, and reduction of the 100 per cent SO_2 gas. In the first ammonia is used as an absorbent for SO_2. Explained briefly, the gas goes through one or several absorbing towers in series, the resulting product being a concentrated solution of ammonium bisulphite. The sulphur dioxide is recovered from the ammonium bisulphite solution by two methods: (1) Sulphuric acid is used to displace the sulphur dioxide and form ammonium sulphate (crystallized into a commercial product) with the production of 100 per cent sulphur dioxide gas; and (2) the ammonium bisulphite solutions are heated, driving off part of the sulphur dioxide and producing a solution of ammonium monosulphite, which is returned to the absorption towers.

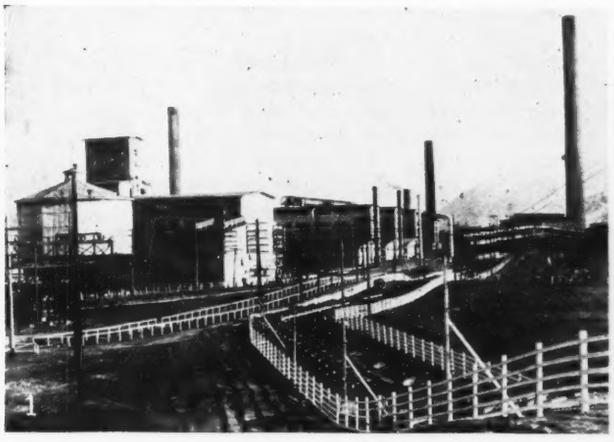
A part of the sulphur dioxide recovered is used in sulphuric acid production and a part is reduced to elemental sulphur. The reduction to elemental sulphur is accomplished by passing the sulphur dioxide, mixed with pure oxygen, through incandescent coke (a furnace of the standard water-gas producer type), resulting in the production of carbon dioxide, elemental sulphur, some carbon oxysulphide, and carbon monoxide which unites with sulphur to form carbon oxysulphide in the cooler part of the furnace. An additional amount of sulphur dioxide is mixed with this gas, and the mixture passed through a catalyst column (brick-lined tower), where the sulphur dioxide reacts with the carbon oxysulphide. From the catalyst column the gases pass through waste-heat boilers, and the gaseous sulphur is condensed out in the form of mist and liquid. Mist sulphur is passed through Cottrell treaters, with a recovery of liquid sulphur. Daily plant production amounts to 60 tons of elemental sulphur of more than 99.95 per cent purity.

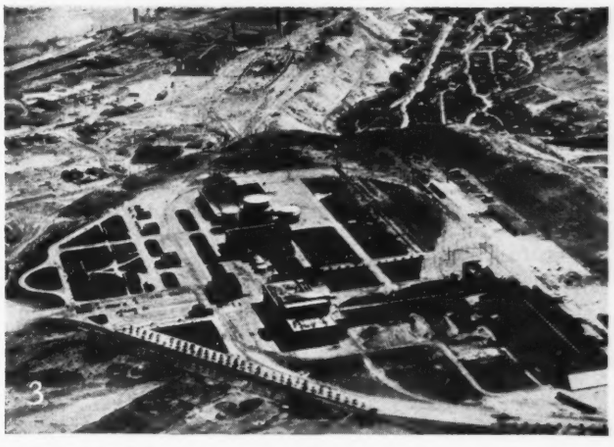
The Fertilizer Plant—The availability of cheap and abundant electric power underlies the selection of electrolysis of water as a source of hydrogen necessary for ammonia synthesis. For this work there are available 1,944 Fauser (Italian) and Knowles (English) cells. Both are of the tank or bell type, 10,000 amp., the complete installation producing about 19 tons of 99.8 per cent hydrogen and 153 tons of 99.3 per cent oxygen a day. The cells are in series, and the cell electrodes in each tank in parallel. Each electrode is surmounted by its common bell for collecting evolved hydrogen or oxygen gas, which is directed first into the cell gas collector and then to the battery mains. Electrolyte used is a 25 per cent caustic potash solution or an 18 per cent solution of caustic soda. Replacement of decomposed water is by continuous feed of distilled water obtained from two Escher-Wyss Company units with a combined capacity of 350 tons of water a day. Direct current for electrolysis is furnished by one G.E. and five Brown-Boveri mercury-arc, 10,000-amp., 650 to 830-volt rectifiers requiring 44,400 kw.

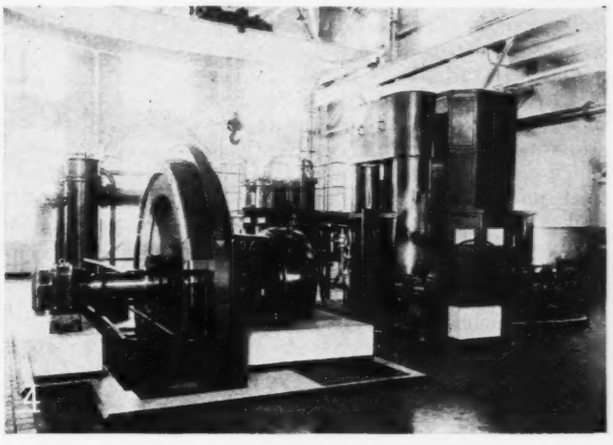
Nitrogen is produced by standard methods. Briefly, it involves air compression, compressed-air purification, cooling of compressed purified air to temperature of liquefaction, and fractional distillation of liquid air. In the nitrogen plant there are installed two standard Claude liquid-air units, each of a capacity of 46 tons a day in terms of nitrogen.

In the ammonia plant the Fauser operation, the gas is directed to the four main synthesis units, each consisting of a long 90-ton synthesis column with internal catalyst containers, heat exchangers, and heating elements; a cooler composed of banks of water-jacketed high-pressure pipes; a condenser; an ammonia evaporator; and a high-pressure gas circulating pump. The capacity of each unit is equivalent to about 30 tons of ammonia a day

enters the serpentine coils of the evaporator, where it is surrounded by a boiling bath of ammonia at minus 25 deg. C. The flow then returns to the condenser, where all ammonia condensed accumulates, and which volume is measured electrically. Next, it is drained to the evaporator body, the evaporated ammonia going via the distributing main to consuming plants and the surplus liquid ammonia being







1. SO_2 RECOVERY PLANTS at Trail. Left to right: the SO_2 reduction building; three contact acid plants; the SO_2 absorption plant. At extreme right is the zinc plant stack. Pipe lines in foreground convey steam and sulphuric acid to the fertilizer plant. . . . 2. THE SYNTHETIC AMMONIA PLANT. Here the Fauser process is used. Hydrogen is obtained by the electrolysis of water and nitrogen by standard methods. . . . 3. AN AERIAL VIEW of the Consolidated's chemical and fertilizer plants at Trail. . . . 4. IN THE LIQUID AIR PLANT for nitrogen. Here are installed two standard Claude liquid air units, each of a capacity of 46 tons a day in terms of nitrogen

ammonia synthesis process is used. As operated, about 105 tons of ammonia is produced a day. Gas storage consists of two gas holders, one 421,-200-cu.ft. unit for hydrogen, and one 245,700-cu.ft. unit for nitrogen, from which the gases are withdrawn in the ratio of 1:3 (N:H) and then passed to two Canadian Ingersoll-Rand, six-stage, high-pressure compressors, each equivalent in capacity to 54 tons of pure ammonia a day. Gas compressed to around 3,000 lb. per square inch goes through oil and condensate traps before entering a precatalysis cycle for removal of residual oxygen. After separation of the water formed in this

Treatment received in the aforementioned equipment is as follows: The gas enters the top of the synthesis column at about 20 deg. C., passes down around the main wall for protection of the column against high temperatures, then up through the heat exchanger and catalyst, container tubes, down through the catalyst mass at about 450 deg. C., then down around the heat exchanger tubes, and finally out from the column at 125 deg. C. At this point the gas contains about 12 per cent ammonia by volume, which represents a recovered conversion of 21 per cent. After being cooled to 0 deg. C. in the condenser, the flow

drained to a 30-ft. insulated Hortonsphere for storage.

Production of the divers fertilizer products—namely, ammonium sulphate, ammonium phosphate-sulphate products, ammonium phosphate, superphospate, and triple super-phosphate—is accomplished by mixing two or more raw materials (ammonia, sulphuric acid, phosphoric acid, and phosphate rock) in different ways. For instance, by mixing ammonia and sulphuric acid, ammonium sulphate results; a wide range of ammonium phosphate-sulphate products can be made by mixing ammonia, phosphoric acid, and sulphuric acid; a mixture

of ammonia and phosphoric acid gives ammonium phosphate; phosphate rock and sulphuric acid results in super-phosphate; and triple super-phosphate is produced by a mixture of phosphate rock and phosphoric acid.

Phosphoric acid and phosphates are produced by a process developed by the Dorr Company and modified by Consolidated Mining & Smelting Company. Production of phosphoric acid from phosphate rock imported from Montana involves grinding the rock, digestion with sulphuric acid, and separation of the resulting phosphoric acid from the residual byproduct gypsum. Equipment used in these operations includes six pebble mills, seven mechanical agitators, Dorreo filters, and Swensen evaporators. The process results in the direct production of acid of higher concentration (30 per cent P_2O_5) than is usually obtained by the wet method. As built, the plant consists of three units, each having sufficient capacity for leaching 150 tons of phosphate rock.

Contiguous with the phosphoric acid plants are three fertilizer units, each of which can be used interchangeably for either triple super-phosphate or mono-ammonium phosphate. Here, treatment involves neutralization of acid, drying, sizing, dust collection, and re-treatment. Machinery used in this work includes three mechanical agitators, a Dorreo blunger, a Struthers-Wells dryer, a Jeffrey pulverizer and Raymond cyclone, two Hum-mer screens, and conventional conveying equipment. Daily output of each unit is about 120 tons.

The ammonium sulphate plant is equipped for producing ammonium sulphate either direct from ammonia and sulphuric acid or from ammonium sulphate solution obtained from the sulphur dioxide recovery plants. When operating on the first process the plant capacity is about 240 tons of finished salts per day, and treatment calls for neutralization of sulphuric acid with ammonia in saturators, in this case 10-ft. hard-lead kettles, into which both ingredients are fed continuously, followed by centrifuging for crystal and mother liquor separation in Haubold centrifuges, and crystal drying in Pehrson dryers, where the moisture content of the finished product is reduced to 0.05 per cent. Temperature, retention, agitation, and chemical conditions control the crystal size and shape. In centrifuging, water washing is practiced to control the free acid in the crystal. The second process differs from the first in that the ammonium sulphate solution from the sulphur dioxide recovery plants is evaporated and crystallized in four Oslo crystallizers, followed by centrifuging and drying in the machinery mentioned previously. About 120 tons of salt per day per unit are produced in this manner.

The phosphate rock drying and grinding plant contains an 8-ft. by 48-in. Hardinge mill with an air-classification system, Struthers-Wells dryer, two Fuller-Kenyon dust pumps, and conveying and storage equipment. At the super-phosphate division (capacity 200 tons per day) a 1½-ton Stedman mixer and auxiliary weighing and ventilating machinery are in use. The fertilizer storage house has a capacity of 100,000 tons, and contains five 20-ton per hour capacity shipping mills served by a 7-ton crane with a grab bucket. Products are shipped both in bulk and divers bags.

Besides the plants described in the aforegoing, there are at the smelter proper well-equipped repair shops and a warehouse with a total floor space of 83,676 sq.ft.; a lead-ore sampling mill; 100 tons per hour crushing plant and a 600-ton concentrator for custom ores; laboratories; Prodorite plant, where electrolytic zinc cells are manufactured; and a lead rolling mill for making lead sheet and pipe for local use. The Cottrell treaters at the lead and zinc plants are principally of the plate type, with standard equipment being used in the rectifier rooms. Total power requirement at the reduction works, including the Warfield plants, amounts to about 168,000 hp., the current being supplied by the West Kootenay Power & Light Company, Ltd., a company subsidiary with power plants on the Kootenay River some 30 miles distant. The company also operates one of the best dairy farms in Canada.

In conclusion, I wish to express my appreciation to S. G. Blaylock, vice-president and general manager, for permission to publish the articles on the operations at Kimberly and Trail, and thanks are due to all department heads for the courtesies shown me at the different plants and for the data contained in the aforegoing accounts.

▼ ▼ ▼

Cost of Drifting and Crosscutting In Developing a Prospect

William H. Harrison, Jr.
Mining Engineer
Idaho Springs, Colo.

FIGURES given in the accompanying table represent actual costs obtained in drifting and crosscutting by contract for development purposes only. The property was a prospect in the Idaho Springs district in Colorado. Four workmen and a superintendent were employed. The four comprised a contract miner, a contract mucker, a hoistman, and a general utility man, who trammed the rock hoisted to the waste dump, looked after the compressor and pump, and was generally useful.

The ground was schist, fairly easy to drill and break. The contractors mucked into Montana-type buckets and delivered the muck at the shaft, where it was hoisted 165 ft., dumped into cars, and trammed 250 ft. to the waste dump.

Pumping was done while the contractors were setting up, during the lunch period, and as soon as all muck was hoisted. Pumping time averaged about three hours per day.

Work was carried on for the full 30-day month of June. Total advance for the month was 122.25 ft.

Wages paid were: Hoistman, $4.75 per shift; general utility man, $4.50. The men on contract received $3.50 per foot, with all supplies furnished. Major items of the latter were: powder, caps, fuse, timber, drill bits, and drill steel. The wages paid for the non-contract work are slightly above the average for the Idaho Springs region. Men so paid, however, did other work also when this could be done without interfering with the progress of the development work.

Prospect Development Costs

	Cost/Ft. Advance
Drifting	
Labor	$3.500
Supplies	0.628
Powder caps and fuse	1.108
Power compressor	1.044
Compensation insurance	0.258
	$6.538
Pumping	
Materials	$0.190
Labor	0.368
Power pumps	0.112
Compensation insurance	0.026
	$0.696
Hoisting	
Labor	$1.390
Rent hoist	0.204
Power hoist	0.280
Compensation insurance	0.102
	$1.976
Overhead and Supervision	
Supervision	$1.276
Assays	0.332
Compensation insurance	0.096
	$1.704
Grand total	$10.914

In Search of

a Better Drift Set

Tests with models suggest some ideas in respect to mine timbering

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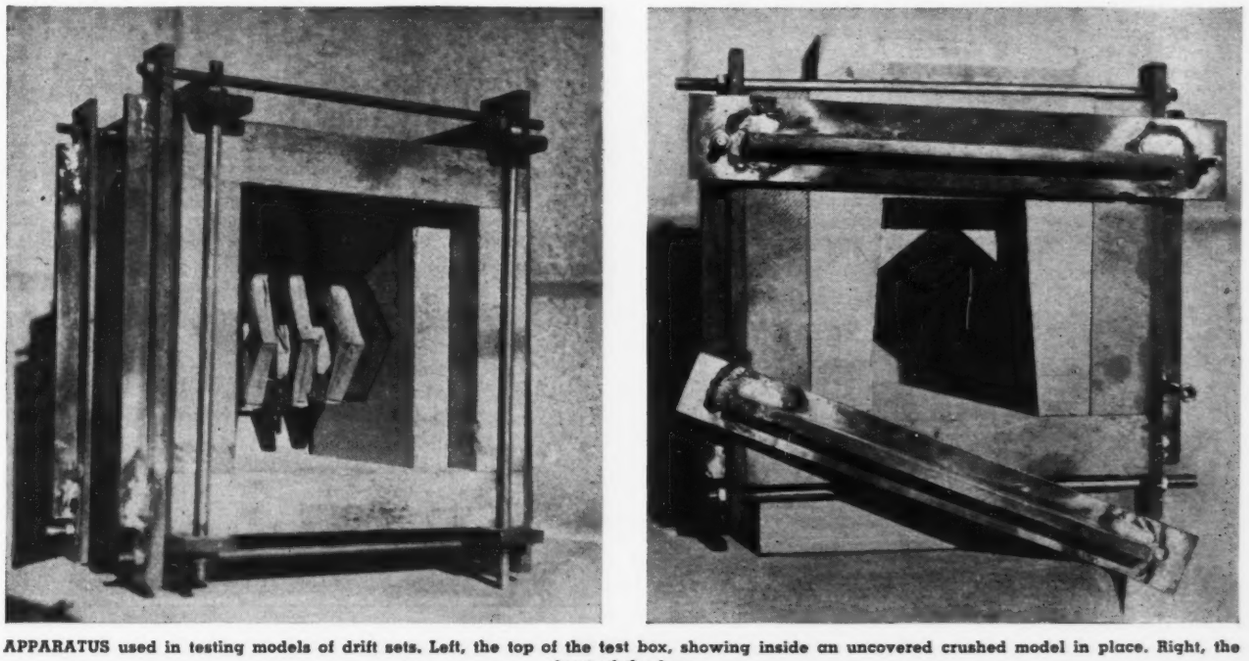
NEED EXISTS for a drift set which will maintain swelling and moving ground for a longer time than sets of the usual design do. It appeared feasible to construct and test model sets of different design so that their comparative strengths could be obtained. This work was done in the mining department of the University of California.

Method of Testing—Pressure conditions and the proportion of side to roof pressure vary from point to point along a drift, but in general the top pressure is the greatest and comes on first after a drift has been opened. Locally, hard-rock blocks may be forced in with the more or less plastic rock around them, which may break a post without breaking the lagging or posts on either side of it. No design of set will prevent this, so only the action of fairly uniform pressures can be considered.

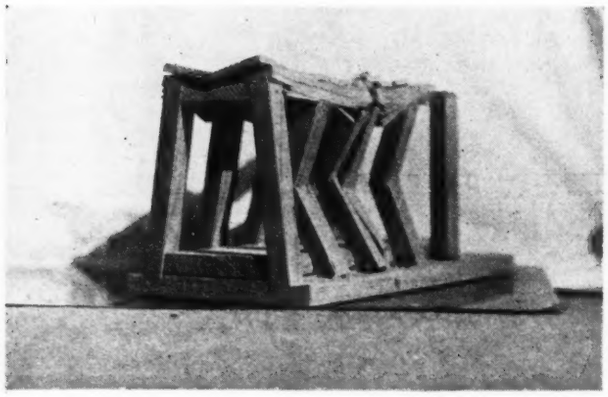
Rock pressure is due to the weight of the overlying rock, and in some types of rock there is an added pressure from the swelling of the exposed ground. Inasmuch as the pressure from the swelling action is nearly constant at all points around the opening, it does not affect the net difference in pressure between the walls and back, when combined with the static pressure of the overlying rock. Hence, actual pressure conditions can be simulated closely by merely applying a static load to sand covering the model.

This was done by placing the models in a heavy box and covering them with a fine-grained sand to a constant depth for all tests, and applying pressure to the sand with a block similar to a piston in a cylinder. The apparatus, shown in the photographs, was placed in a 60,000-lb. Olsen testing machine and the loads applied were recorded for the important stages of collapse of each model. The maximum load which most of the models would resist was usually the point of major collapse, after which the load resisted became rapidly less and the models closed up. However, some of the models gradually closed in without a definite major collapse, with the load resisted continually increasing. On these later models, the load chosen for calculation of relative strengths was that at which it was estimated that men and materials could no longer pass conveniently in the full-sized set under the same stage of collapse. An opening in the side of the testing box for inserting the models allowed observance while the pressures were applied. The head of the testing machine descended at the rate of 0.05 in. per minute, which made each test last 30 to 50 minutes. Tests were conducted slowly so that the wood fibers would have time to adjust themselves without the breaking which occurs when they are suddenly stressed.

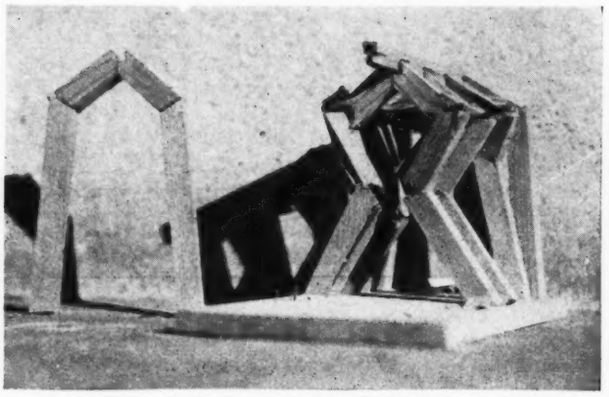
The models were constructed on the scale of 1 to 20, from fine-grained, air-dry redwood. The crushing, shearing, and breaking strengths of such redwood have more nearly correct proportions and values with respect to those of the usual Western sawed mine



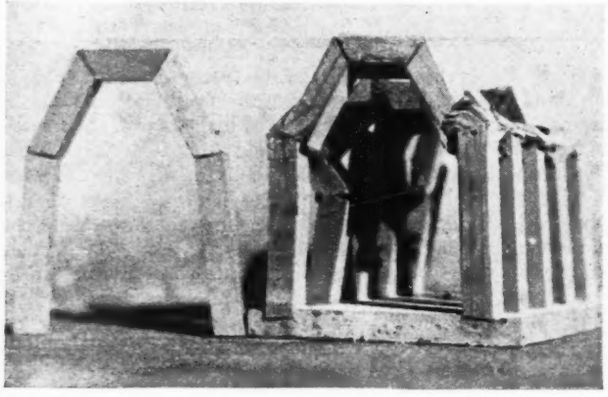
APPARATUS used in testing models of drift sets. Left, the top of the test box, showing inside an uncovered crushed model in place. Right, the front of the box



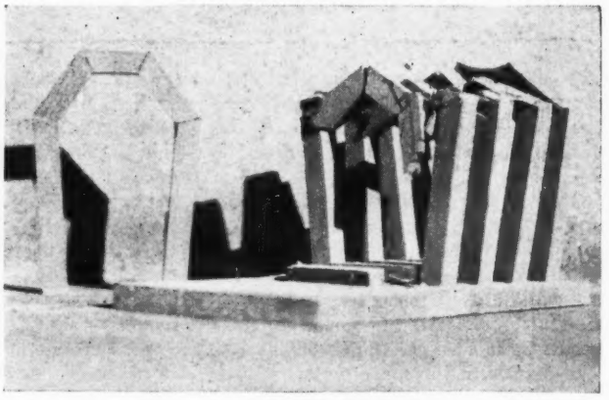
SET 1. Stringers have been crushed and the posts split. This set is used as a basis for calculating relative strengths of different designs of sets



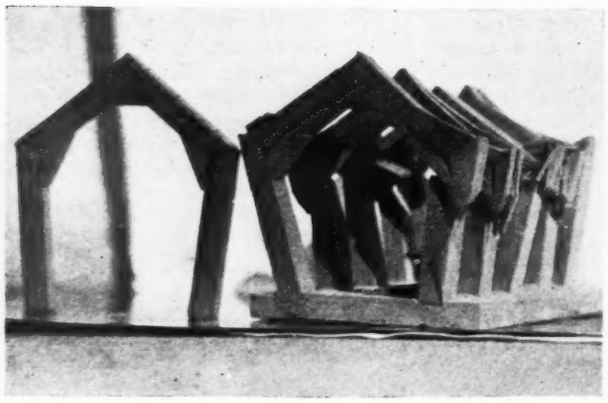
SET 2. This has only half of the strength of Set 1. The posts break first, and after this the set closes rapidly in the manner here shown by the camera



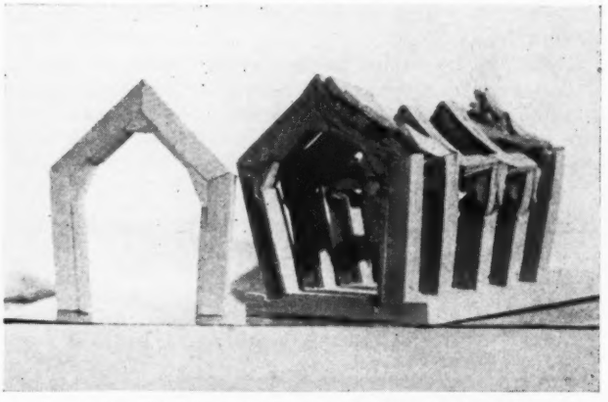
SET 3. This is 18.7 per cent stronger than Set 1. It continues to hold an increasing weight for some time after the arch members have sheared and the posts failed, as shown here



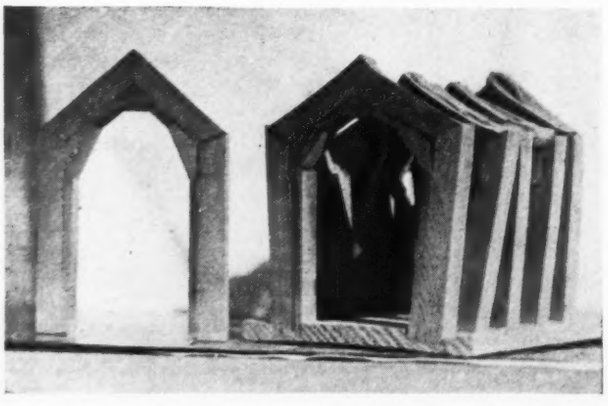
SET 4. About 3 per cent stronger than Set 1, this set has the posts unbroken although the arch members have sheared at the joints, as can be seen



SET 5. This is 11.3 per cent stronger than Set 1, has fair rigidity, and is easy to assemble, although the framing is complex. The block braces have sheared off the tops of the posts



SET 6. This has rigidity and strength, the latter being 23.1 per cent greater than that of Set 1. It fails as does Set 5 but has no definite point of collapse. Scabs and block braces support outer members



SET 7. This is 27 per cent stronger than Set 1. Note how the rafters have sagged instead of breaking and how well the posts have maintained themselves

timber than any other wood. From this it was assumed that the manner and order in which the different members would fail would approximate closely that of the full-sized mine sets. This was proved by testing a model of the grizzly drift set used at the Inspiration copper mine, in Arizona. The test showed that the model failed in exactly the same manner and order as did the mine sets at this mine, as observed by the writer. See Set 1. All posts and stringers were made from half-inch stock to represent 10x10 in. The lagging covered the models solidly to retain the sand and was extra heavy, representing 3x

12-in. material, so that it would not break before the model and let the sand come in. The lagging was cut to a length equal to the distance between centers of the posts. Thus, the pressure was transmitted to the model without the reinforcement of lagging reaching across several posts.

In testing arched sets, it was found that if the models were constructed with the posts vertical, they would assume about the right amount of inward batter when the first loading came on. The toggle action of the arch spreads the tops of the posts

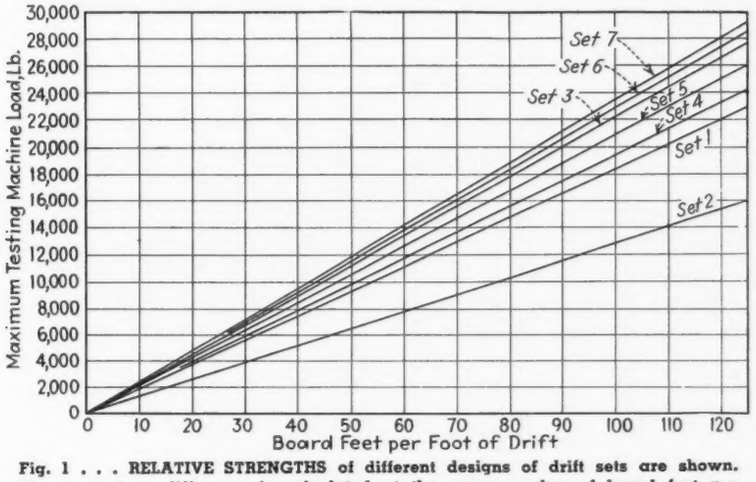


Fig. 1 . . . RELATIVE STRENGTHS of different designs of drift sets are shown. The percentage difference is calculated at the same number of board feet per foot of drift for all designs

apart as the first pressure comes on the roof before it begins to be transmitted around to the sides. This causes the joints to open up somewhat, but they later close and become tight as the members give and push into each other. Those sets shown with the posts vertical would, in actual practice, be constructed with the posts battered inward about 10 to 12 in. in 5 ft. of post length, inasmuch as the rigid walls will prevent spreading of the tops of the posts by the toggle action of the arch. The blocking between the walls and the tops of the posts should be placed with the grain perpendicular to the posts, as the crushing strength parallel to the grain is about eight times that perpendicular to the grain. This will greatly prevent the joints from opening up. All other blocking should be placed with the grain parallel to the member being blocked. This acts as a cushion and delays impairment of the timber.

Observations on the Tests—Set 1 is used as a basis for calculating relative strengths of the different designs. It is of the same design as that used in the grizzly drifts of the Inspiration copper mine. In the test, the top lagging breaks first, pushing out the lateral collar braces, but this is not so detrimental because the roof has sagged enough in the center to keep the posts from coming in at the top. The stringers next crush badly and split posts supporting the ends of two stringers. This splitting can be eliminated by placing a head board between the post and the stringers. Lastly, the posts break near the center, after which the set quickly closes. This set is recommended for ground in which there is moderate pressure and little or no swelling, such as drift mines, or drifts under filled or shrinkage stopes. Its advantages are: simplicity of design, framing, and assembly; low costs; its use tends to keep the drift straight in moving ground; and the drift round is easy to break. Disadvantages are: the stringers are a weak part of the design, due to the grain being perpendicular to the direction of the pressures from the posts, collar braces, and rock; and the members are long and difficult to handle.

Set 2—This set is only half as strong as Set 1. The posts are the first to break, after which the set rapidly closes. This is due to the pitched roof diverting the pressure around to the long posts which are battered outward. There is nothing to recommend this set, except, possibly, for use in ground in which there is considerable roof pressure but no side pressure.

Set 3—This is 18.7 per cent stronger than Set 1. The three-piece arch fails first by shearing across the grain at the joints. The posts then break near the center, but the set continues to hold an increasing weight for some time after this. The toggle action of the arch causes the joints to open slightly, thereby hastening failure. This opening of the joints would also occur in the mine, to a lesser extent, due to the giving of the blocking and the rock behind it, which in some cases may be soft. The advantages are: the set continues to maintain weight after failure has occurred; the members are short, making handling and assembly easy; and the cross-section of the drift must be arched, which also aids in maintaining the rock. The disadvantages are: three different cuts of timber must be used; there are four joints which are points of weakness; framing and assembly are complicated; and the posts are battered outward, another weak point. This set is recommended for heavy and swelling ground.

Set 4—This is 3.1 per cent stronger than Set 1. Failure here occurred by the arch members shearing at the joints. The posts are one foot longer than those in Set 3, but being battered inward did not break. The advantages and disadvantages are the same as those in Set 3. These two sets allow sufficient headroom with the use of shorter posts.

Set 5—This design is 11.3 per cent stronger than Set 1. The keyed block braces strengthen the joints and give the main members more bearing in both longitudinal and transverse directions. This also shortens the span of the beam action of the members. The joints opened up under the first pressure but closed again with more pressure. The block braces sheared off the tops of the posts and sheared the rafters in a longitudinal direction. Hence, keying the blocks has no special advantage and requires complex framing. Therefore, in sets 6 and 7 the blocks were butted against scabs nailed to the posts, which simplified framing and assembly. The advantages of this set are: strength and rigidity; fairly easy assembly, shorter members making handling easy; and an easy round to break. The disadvantages are: complex framing; five different cuts of timber are needed; and main members are weakened by the notches cut for the block braces. This and sets 6 and 7 are recommended for use in heavy and swelling ground, and especially for control drifts under block-caving stopes where the ground is subject to considerable movement.

Set 6—This is 23.1 per cent stronger than Set 1. It fails similarly to Set 5. Advantages are: rigidity and strength; the set has no definite point of collapse and takes a continually increasing load, as do also sets 5 and 7; the scabs strengthen the posts and do not buckle as did the pieces sheared off in Set 5, since they are nailed to the posts; ample headroom with short members; and the span of the beam action of the members is

(*Continued on page* 55)

Open-Pit Transport On the Mesabi Range

II — *Steam Haulage Versus Electric Haulage*

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Mechanical Engineer
Hibbing, Minn.

IN THE FIRST ARTICLE of this series[1] the various types of ore transport and haulage used in the open-pit work on the Mesabi range were described in a general way. Specific installations were cited. The basis for making a selection of any particular type of transport, or haulage, in preference to others, where a pit is to be equipped or the existing transport scheme changed, will now be discussed by analyzing the costs determined for each system with reference to an average open-pit mine. Comparison will first be made between steam locomotives as formerly used in this pit and up-to-date electric locomotives of similar size. As most mines differ from each other in some respects, an attempt has been made to select a pit presenting most of the haulage problems that must be solved by the mine operator and that are to be considered here.

The pit chosen for the study is situated on the west end of the Mesabi range, in Minnesota, and was one of the first to be opened after beneficiation of sandy ores was proved economical, more than 25 years ago. From it has been mined over 12,000,000 tons of concentrates, with 7,000,000 still available.

The estimates that are presented have been prepared from data submitted and guaranteed by makers of electric haulage equipment, of tractors, conveyor belts and trucks, covering experience in haulage and transport not only on the Mesabi range but on large contract jobs on dams, construction, coal stripping, and work of similar kind.

The conditions governing the problem presented to the various makers of haulage equipment are specified in the following paragraphs. Some of the items pertain only to electric and steam haulage, but for all cases where they apply the quantities are the same.

[1] Published in the October, 1938, issue.

1. Fig. 1 shows the location of the pit and the washing plant and the track layout between the two. Figs. 1 and 2 give clear detail of tracks with detail of switch layouts in the pit. Tracks drawn in full line in Fig. 1 are permanent including the line to the shops. The track into the pit in Fig. 1 is permanent from elevation 716 in the northeast corner around north, west and south sides to elevation 620.

2. The output of the mine for the season is 700,000 long tons of concentrate, corresponding to 1,050,000 long tons of crude ore which is taken from the area enclosed within the triple broken line in the pit in Fig. 1. Destination is the concentrator or washing plant. Weight of the crude ore is 1 long ton per 14 cu.ft.

3. Amount of stripping is 500,000 cu.yd. from the area just south of the pit where the outline of the bank in Fig. 1 projects sharply into the pit. Destination is the stripping-dumps in the region north of the washing plant and east of the tracks leading to the washing plant. Weight of stripping used in calculating the estimated figures is 1¼ long tons per cubic yard.

4. Number of 4-cu.yd. electric shovels 2

5. Number of steam trains used during period covered..... 4

6. Number of 30-cu.yd. cars used per train 4

7. Hours per shift..... 8

8. Shifts per day..... 2

9. Working days per ore season (without overtime) 120

10. Total number of 8-hour shifts in ore 240

11. Working days in stripping season 80

12. Total number of 8-hour shifts in stripping 160

13. Loading time per 30-cu-yd. car, including spotting, minutes..... 5

14. Dumping time per car, minutes 1

15. Cycle time for each steam train, minutes 75

16. Maximum long tons of crude ore per 8-hour shift..... 5,000

17. Weight of old type 30-cu.yd. car, lb. 72,000
Weight of new type, light-weight, 30-cu.yd. ore car, lb..... 58,000

18. Live load per 30-cu.yd. car in long tons 55

19. Steam locomotives, 67 tons on drivers, 19x26-in. cylinders, 50-in. wheel, 180-lb. steam pressures, rated tractive effort 28,200 lb., weight of tender 51 tons.

20. Labor rates per hour:

Locomotive engineer	$0.99
Locomotive fireman	0.76
Switchmen	0.625
Trackmen	0.625
Electrician foreman	0.795
Electrician assistant	0.66

21. Number of men in steam locomotive crew: engineer, fireman and brakeman when train is attached. Electric locomotive may use engineer only because brakeman will be in cab with him.

22. Elevation of bottom of pit at end of life, ft.....460

23. Life of mine, years..... 12

24. Steam operating costs:

(a) Coal used when 980,000 long tons of crude ore was hauled in 72,000-lb. 30-cu.yd. cars and bottom level of pit was at elevation 582 ft., tons.....4,973

(b) Cost per ton of coal, present day, f.o.b. mine $7.25

(c) Time per 8-hour shift for coaling and water per locomotive, minutes... 30

(d) Locomotive maintenance (using average for 5 years and including back shop as well as running repairs) per year per locomotive $2,000

(e) Oil and waste per day per locomotive $1.25

25. Weight of rails on main-line load track, lb. 90
Weight of rails on main-line, return track, lb. 80

26. Minimum radius of curvature, degrees 25

27. Distance between track centers on double track: standard 16 ft., minimum 14 ft.

28. Number of miles of temporary track shifted per year, estimated.... 5

29. Shovel power per long ton ore, kw-hr. 0.22

30. Shovel power per cubic yard stripping, kw.-hr. 0.40

Steam Haulage vs. Electric Haulage

To summarize at the outset the necessarily lengthy comparative analysis of the costs of steam haulage and electric haulage with respect to the pit selected, the large amount of data presented in Table III to Table XI inclusive and in the text indicates a positive saving of 6.58c. per ton of concentrate for electric haulage as compared with steam haulage, assuming an annual production of 700,000 long tons of concentrates, including the haulage of 500,000 cu.yd. of stripping, as stated in conditions 2 and 3. This result may be calculated from the data in Table I, which is a recapitulation of the salient facts given in the summary Table II.

The detailed analysis whereby the data were derived is presented in the following pages.

Nature of Haulage Conditions—There will be two 4-cu.yd. shovels in the pit which will load crude ore into 30-cu.yd. dump cars. These will be hauled in train, on standard-gage track, through a series of switchbacks out of the pit to the washing plant, where the load will be dumped, the train then returning empty to the shovel.

Elevation of the washing plant is 840 ft. and the present level of the bottom of the pit is approximately 580 ft. The total rise from bottom of pit to washing plant is therefore 260 ft. Length of run is approximately 4.4 miles, representing an average gradient for the entire distance of slightly more than 1 per cent against load.

The sketches in Figs. 1 and 2 show the track layout in the pit and on the main line, and a few typical shovel locations. The shovel locations and track arrangement, particularly in the pit, change rapidly from time to time, but ordinary variations from an assumed arrangement will have but slight effect on the ultimate cost of electrification and the cost of operation. Hence, for the purpose of this analysis, it has been assumed that ore haulage will be from the typical shovel locations shown in Fig. 2, on the 580- and 600-ft. levels.

Table I—Recapitulation of Costs Steam Haulage vs. Electric Haulage

Investment	
Electric	$232,000
Steam	162,000
Capital increase	$70,000
Annual Operating Expense, Including Fixed Charges	
Steam	$167,015
Electric	120,950
Annual saving by electric operation	$46,065
Returns Shown by Electric Operation	
On gross investment, per cent	19.8
On capital increase, per cent	65.8

Some of the switchbacks in the pit are on grades averaging from 2.25 to 2.7 per cent. Maximum grades on these switchbacks, including curvature which has been compensated at 0.8 lb. per ton per degree, run from 3.2 to 3.4 per cent.

On the main line the grades are in general not so steep as in the pit. However, average grades of 2.1 to 2.4 per cent are encountered, together with a short (450 ft.) compensated, maximum grade of 3.0 per cent.

It is recognized that the grades in the pit will change as the pit becomes deeper and as tracks are rearranged. The grades on the main line, however, will presumably remain as at present.

Locomotive Selection—The cars which are to be used for ore haulage are 30-cu.yd. side-dump cars which have a light weight of 58,000 lb. The estimated weight of ore per car is 55 long tons, or 123,000 lb., giving a total loaded weight of 181,000 lb., or 90.5 tons, per car. Complete data on car and train weights are included in Table III.

The choice of number of cars per train involves consideration of grades and length of haul, digging rate of shovels, number of shovels, capacity of washing plant, and the maximum amount of ore which has to be produced in a given length of time. Other considerations, such as cost of equipment and the selection of locomotives of standard design, have some influence in deciding on the number of cars per train.

In this particular case the average output of the pit is 4,375 long tons in 8 hours and the maximum output has been set at 5,000 long tons in 8 hrs. The capacity of the shovels when

Table II—Summary and Comparison of Haulage Costs, Open-Pit Mine, Steam Operation vs. Electric Operation

Summary Steam Operation	
Capital Investment	
4 Steam locomotives, 67-ton	$160,000
Renovation of steam facilities	2,000
Total steam investment	$162,000
Operating Expenses	
Electric power for pit, shovels, and washing plant	$47,227
Locomotive fuel	47,408
Locomotive maintenance	8,000
Crew wages, engineers	12,672
Crew wages, firemen	9,728
Crew wages, brakemen	8,000
Lubricants	1,000
Water	1,300
Engine house	2,400
Electric maintenance of shovels and washing plant	3,360
Steam operation expense	$141,095
Fixed charges at 16 per cent	25,920
Total steam operating and fixed charges	$167,015
Total electric operating and fixed charges	120,950
Annual saving electric operation	$46,065

Summary Electric Operation		
Capital Investment		
4 Electric locomotives, 65-ton		$130,000
12.05 miles distribution system		60,000
1 Substation 750-kw. capacity		42,000
Electric investment, gross		$232,000
Steam investment		162,000
Capital increase		$70,000
Operating Expenses		
Electric power for pit, shovels and washing plant	$47,227	
Electric power for haulage	13,360	
Total electric power		$60,587
Locomotive maintenance		3,445
Crew wages, engineers		11,088
Crew wages, brakemen		7,000
Lubricants		50
Electric maintenance of shovels, washing plant, substation and distribution system, including shifting of 5 miles of overhead contact wire		8,620
Electric operation		$90,790
Fixed charges at 13 per cent		30,160
Total electric operating and fixed charges		$120,950

Electric operation shows a return on gross investment of 19.8%.
Electric operation shows a return on capital increase of 65.8%.

NOTE: 700,000 long tons concentrate (equivalent to 1,050,000 long tons crude ore) 500,000 cu. yd. stripping.

Table III—Train Weights

	Ore Haulage	Steam	Electric
(a)	Number of 30-cu. yd. cars per train	4	4
(b)	Light weight of car, tons	29	29
(c)	Weight of ore per car, long tons	55	55
(d)	Weight of ore per car, short tons	61.5	61.5
(e)	Weight of loaded car, tons	90.5	90.5
(f)	Weight of locomotive, tons on drivers	67	65
(g)	Weight of locomotive, tons total	138	65
(h)	Total weight of light train, tons	254	181
(i)	Total weight of loaded train, tons	500	427
(j)	Ratio loaded train weight to weight on drivers	7.5	6.6
(k)	Total ore per train, long tons	220	220

	Stripping	Steam	Electric
(l)	Number of 30-cu. yd. cars per train	5	5
(m)	Light weight of car, tons	29	29
(n)	Yards of stripping per car, assumed	31.2	31.2
(o)	Weight of stripping per car, short tons	43.6	43.6
(p)	Weight of loaded car, tons	72.6	72.6
(q)	Weight of locomotive, tons on drivers	67	65
(r)	Weight of locomotive, tons total weight	138	65
(s)	Total weight of light train, tons	283	210
(t)	Total weight of loaded train, tons	501	428
(u)	Ratio, loaded train weight to weight on drivers	7.5	6.6
(v)	Total yards stripping per train	156	156

Fig. 1 . . . SURFACE MAP, showing an open pit on the Mesabi, and vicinity

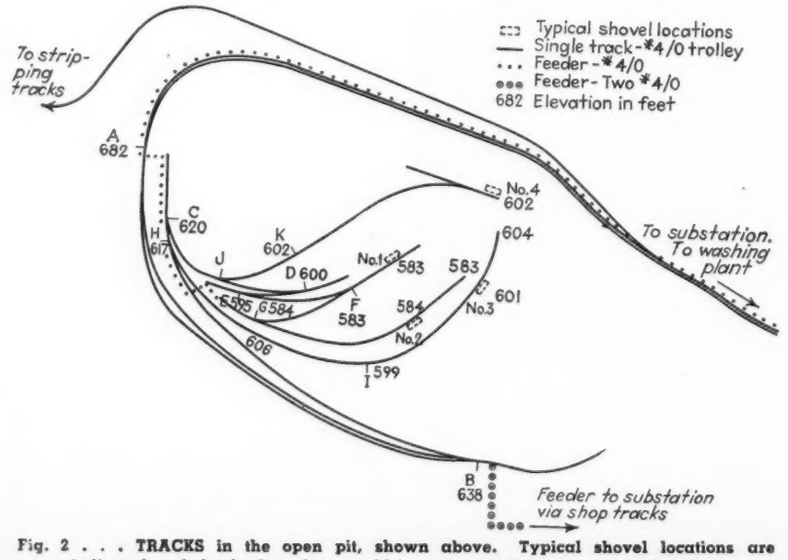

Fig. 2 . . . TRACKS in the open pit, shown above. Typical shovel locations are indicated and the feeders that would be required if the pit were electrified

serving from 4- to 6-car trains is as follows:

	4-Car Train	5-Car Train	6-Car Train
Loading time at five minutes per car.....	20	25	30
Shovel waiting time, on average	4	4	4
Total time of shovel cycle, min.....	24	29	34
Long tons of ore per train	220	275	330
Maximum long tons of ore produced in 8 hours by one shovel	4,440	4,550	4,660

In either of these cases it is observed that one shovel will produce the average requirement of 4,375 long tons, and that two shovels will be required to produce the maximum day of 5,000 long tons. Two shovels could produce from 8,800 to 9,320 long tons in 8 hours, but there seems to be no reason for providing a haulage system which will haul this amount, when the required maximum, which is understood to be the capacity of the washing plant, is 5,000 long tons.

As the capacity of the haulage system is based on a maximum production of 5,000 long tons per 8 hours, it is apparent that when two shovels are working to produce a maximum day, each one will be operating at reduced capacity of 2,500 long tons, which means that the shovels will have considerable waiting time between trains. Under the conditions this is unavoidable and is presumed to be acceptable as far as this analysis is concerned.

A 4-car train can be hauled over the existing profile by a standard 65-ton locomotive, whereas 5- and 6-car trains will require locomotives weighing 80 to 100 tons. The latter locomotives, in standard design, would be faster than the 65-ton locomotive, which would result in more locomotive waiting time, but would not be enough faster to reduce the required number of locomotives. It would be possible to supply a locomotive large and fast enough to bring about a reduction in number of units required, but the cost would be high and the cost of additional copper in the distribution system and additional peak capacity in the substation to take care of the increased power demands of such a locomotive would increase the total cost of the installation to the point of impractibility.

From the standpoint of power cost, particularly where there is a penalty for short-time peaks, a more favorable rate is obtained by the use of a large number of small trains. However, if carried too far this advantage will be offset by increased cost of crew labor, or first cost of motive power units, or both.

These considerations led to the selection of a 4-car train and a 65-ton locomotive as being most suitable. The data in Table III show train weights.

(To be continued)

In Search of a Better Drift Set

(*Continued from page* 51)

shortened by the use of the block braces. Although the block braces and scabs do not appear to have much strengthening value, they form an inner arch which greatly supports and strengthens the outer members. The disadvantages are: somewhat complex framing although easy assembly; more time is necessary for assembly; and rafters are too long, compared to the posts.

Set 7—This design is 27 per cent stronger than Set 1. The relative lengths of posts and rafters are nearly correct, as the test showed that the posts and rafters began failing at about the same time. This set differs from Set 6 by having longer posts and shorter rafters, and the post scabs and block braces were beveled to prevent cutting of the posts as shown in the photograph of Set 7. The rafters do not break but merely sag, due to the support of the block braces and scabs. Advantages and disadvantages are the same as Set 6. A batter was not given the posts in the model, for reasons explained in the foregoing, so if this design is to be used in actual practice an inward batter of about 10 to 12 in. in 5 ft. of post should be made. The longest dimensions of this set are: posts, 6 ft.; rafters, 3½ ft.; scabs, 3 in. thick; and block braces, 6 in. thick by 14 in. long. These dimensions will vary depending on the size of the drift. In laying out templets for this design of set, it should be remembered that the rafters and posts should have their lengths in the proportion of 7 to 12, and that the members should be framed for an inward batter of 10 to 12 in. in 5 ft. of post.

The percentage difference in strengths of the sets is calculated at the same number of board feet per foot of drift for all designs.

Conclusions. The points brought out are: (1) Posts should be battered inward at the bottom instead of outward, as is usually done. (2) The strength of a timbered drift is in direct proportion to the amount of timber used. (3) The two-piece arch roof is strongest for small drift sets.

From the tests it was found that the model posts equivalent to a 5-ft. 10x10-in. timber broke at a machine load of 16,800 lb. when battered an equivalent 10 in. outward, and 6-ft. posts battered inward 8 in. did not break under a 3 per cent greater load (sets 3 and 4). From the flexure formula, it requires approximately 20 per cent more load acting perpendicularly to the long axis of the post to break a 5-ft. post than to break a 6-ft. post of the same cross-section. Therefore, it is seen that the 6-ft. post when battered inward resists approximately 25 per cent more pressure than the shorter post battered outward. This is due to the post carrying more of the vertical pressure in a longitudinal direction (Fig. 2a), and the inward batter conforms more to the angle of repose of the rock, which leaves less of the overlying rock resting on the side of the post, as shown in Fig. 2b.

Of course, the set shown in Fig. 2 with the inward battered posts has an impractical shape and the cap would break quickly, but if the posts are shortened and the cap is replaced by a two-piece arch as in Set 7, these objections are eliminated.

In testing each design of set, four models were made with the sets spaced at different distances apart. The collapsing load for each model was plotted against the board feet of timber per foot of drift used. These four points gave a straight line from the origin, which shows that the strength of a timbered drift increases in proportion to the amount of timber used. In calculating the amount of timber used per foot of drift, only the board feet in the set and collar braces were figured, since the footage of lagging necessary is about the same for any design of set when the area of the openings remains approximately the same. Those sets with the inward batter require a spreader between the bottom of the posts, which is not shown in the photographs, as the posts sank into the model base when the first pressures came on so that the side pressure could not force them in at the bottom. However, in actual practice such a spreader would be necessary, but it need be only a 4x6-in. piece or 6x8-in. at best, and where a track is to be laid, the cost of the spreader can be charged to the track account. The spreaders were included in the timber calculations in this paper.

The relative strengths of different designs of sets are measures of the time they will withstand failure. A set twice as strong as another will last twice as long, assuming that the pressure comes on approximately as a straight line function of the time. Now, if it is wished to prolong the life of a drift, the suggestion may be made to increase the size of the timber instead of changing the design of the set. The main members of a set act essentially as beams, loaded transversely and longitudinally. However, the end loading can be disregarded and the flexure formula used to calculate the relative strengths of timbers of different sizes and of the same length. From this, it is found that if Set 1 is constructed with 12x12-in. timbers instead of 10x10's, the strength would be increased by 73 per cent with an increase of 44 per cent in the volume of timber used. Taking a drift timbered with 50 bd. ft. per foot of drift with Set 1, for example. To increase the strength of the drift with 10x10's by 73 per cent, from the chart, requires 85 bd. ft. per foot of drift. If 12x12-in. timbers are used, only 72 bd. ft. per foot are necessary. But, if the design of Set 7 is used, only 67 bd. ft. per foot would be used, using 10x10's. Hence, it is seen that with the proper design of set, the strength of a drift can be increased greatly without the use of heavier timber and with less timber cost. There is also the added important advantage of easy handling of light timber of short length, which also aids in efficiency and economy in drift timbering.

Double sets—that, is, one set inside another—are sometimes used in heavy and swelling ground. These are expensive, require much larger openings, and need maintenance. It seems possible that a design such as that of Set 7 could be used with greater economy with heavy lagging spaced 5 or 6 in. apart. The extra timber used in double sets could be used to increase the number of sets of design No. 7 in the drift. This would greatly increase the strength of the drift, much less rock would have to be broken and moved, and the opening would be much smaller, so that less rock would be exposed to the swelling action of air and water.

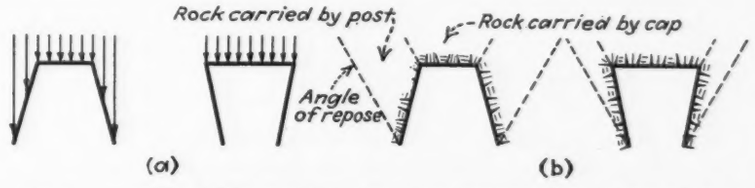

Fig. 2 . . . THE INWARD BATTER of the posts conforms more to the angle of repose of the rock and leaves less of the overlying rock resting on the posts

Summary of the

MARKETS

HEAVY DEMANDS for copper by foreign consumers during the war-crisis period depleted supplies of spot and near-by metal abroad. This temporary shortage caused the price to rise in London, and speculative operations began to expand. The uplift abroad was followed by higher prices in this country. To put a prompt stop to speculative activity that might upset the orderly process of marketing copper, producers participating in the control arrangement quickly increased production in the foreign field from 95 per cent to 105 per cent of basic tonnages and subsequently to unrestricted output. Highly favorable statistics spurred activity and supported higher prices.

The *E. & M. J.* index of non-ferrous metal prices for October advanced to 77.61, a gain of 2.91 points compared with September. Despite the steady advance that has occurred since June, the index remains well under that of a year ago when it was 85.26.

Copper advanced from 10⅜c. to 11¼c., Valley, during the month; Prime Western zinc was raised 10 points; and lead was unchanged. Tin advanced about 1½c. per pound. Platinum and quicksilver declined in price. Antimony was higher. Zinc concentrate advanced, in sympathy with the metal; tungsten ore was firm on developments in the Far East, with manganese ore lower because of increased offerings, chiefly by Russia.

Peaceful settlement of the Czechoslovakian question brought out larger demands for raw materials for peace-time pursuits. In the United States, business activity moved steadily upward, and consumption of non-ferrous metals for October was substantially larger in volume than in the month previous. The undertone in copper, lead, zinc, and tin as the month ended was firm. Domestic copper sales for October totaled 78,288 tons, against 62,232 tons in September. Rumors to the effect that the foreign agreement to restrict lead production had been postponed were denied promptly.

UNITED STATES MARKET

1938	Electrolytic Copper		Straits Tin	Lead		Zinc
Oct.	Domestic (a)	Export (b)	New York	New York	St. Louis	St. Louis
1	10.150	10.125	44.500	5.10	4.95	4.95
3	10.150	10.075	43.500	5.10	4.95	4.95
4	10.150	10.075	43.500	5.10	4.95	4.95
5	10.150 @ 10.275	10.150	43.750	5.10	4.95	4.95
6	10.275 @ 10.400	10.375	45.125	5.10	4.95	4.95
7	10.400	10.425	44.700	5.10	4.95	4.95
8	10.400	10.425	44.700	5.10	4.95	4.95
10	10.525	10.600	45.000	5.10	4.95	4.95
11	10.525	10.700	44.750	5.10	4.95	4.95
12	Holiday	10.700	Holiday	Holiday	Holiday	Holiday
13	10.775	10.825	45.225	5.10	4.95	4.95 @ 5.05
14	11.025	11.025	45.475	5.10	4.95	5.05
15	11.025	11.125	45.500	5.10	4.95	5.05
17	11.025	11.125	45.250	5.10	4.95	5.05
18	11.025	10.800	45.250	5.10	4.95	5.05
19	11.025	10.900	45.700	5.10	4.95	5.05
20	11.025	10.825	45.250	5.10	4.95	5.05
21	11.025	10.800	45.500	5.10	4.95	5.05
22	11.025	10.800	45.600	5.10	4.95	5.05
24	11.025	10.875	45.950	5.10	4.95	5.05
25	11.025	10.925	46.350	5.10	4.95	5.05
26	11.025	11.025	46.250	5.10	4.95	5.05
27	11.025	11.025	46.400	5.10	4.95	5.05
28	11.025	11.025	46.000	5.10	4.95	5.05
29	11.025	11.000	46.250	5.10	4.95	5.05
31	11.025	10.800	46.100	5.10	4.95	5.05
Average For month	10.760	10.713	45.263	5.10	4.95	5.012
Oct.			AVERAGES FOR WEEK			
5	10.160	10.088	44.021	5.10	4.95	4.950
12	10.438	10.538	44.855	5.10	4.95	4.950
19	10.983	10.967	45.400	5.10	4.95	5.042
26	11.025	10.875	45.817	5.10	4.95	5.050
Oct.			CALENDAR WEEK AVERAGES			
1	10.150	9.971	44.250	5.10	4.95	4.95
8	10.275	10.254	44.213	5.10	4.95	4.95
15	10.775	10.829	45.190	5.10	4.95	5.00
22	11.025	10.875	45.425	5.10	4.95	5.05
29	11.025	10.979	46.200	5.10	4.95	5.05

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1938	Sterling Exchange		Silver		Gold	
Oct.	"Checks"	"90-day demand"	(c) New York	London	London	(d) United States
1	4.822500	4.811250	(e)	19.3125	144s 1½d	$35.00
3	4.797500	4.783750	42.750	19.5000	144s 8½d	35.00
4	4.790000	4.776250	42.750	19.6250	145s 3½d	35.00
5	4.802500	4.791250	42.750	19.5625	144s 10d	35.00
6	4.807500	4.796250	42.750	19.4375	144s 5d	35.00
7	4.790000	4.778750	42.750	19.5000	145s	35.00
8	4.782500	4.770000	(e)	19.5625	145s 4½d	35.00
10	4.762500	4.747500	42.750	19.6250	145s 10d	35.00
11	4.761875	4.745625	42.750	19.6250	146s 1½d	35.00
12	Holiday	Holiday	Holiday	19.7500	146s 5d	Holiday
13	4.732500	4.711250	42.750	19.7500	146s 9½d	35.00
14	4.736250	4.716250	42.750	19.6875	146s 10d	35.00
15	4.730625	4.710000	(e)	19.5625	146s 8½d	35.00
17	4.742500	4.726250	42.750	19.5625	146s 6d	35.00
18	4.751250	4.735000	42.750	19.6875	146s 2d	35.00
19	4.768750	4.755000	42.750	19.8125	145s 8½d	35.00
20	4.753750	4.737500	42.750	19.6875	145s 9½d	35.00
21	4.761250	4.746250	42.750	19.7500	146s 2½d	35.00
22	4.757500	4.741250	(e)	19.6875	146s 1½d	35.00
24	4.756875	4.740625	42.750	19.6250	145s 11d	35.00
25	4.760000	4.745000	42.750	19.6875	145s 11d	35.00
26	4.778125	4.763125	42.750	19.6250	145s 9d	35.00
27	4.767500	4.753750	42.750	19.6250	145s 7d	35.00
28	4.765000	4.751250	42.750	19.6250	145s 10½d	35.00
29	4.763750	4.750000	(e)	19.4375	145s 10½d	35.00
31	4.753750	4.740000	42.750	19.6250	146s ½d	35.00
Average for Mo.	4.76785	.....	42.750	19.613	.....	35.00
Oct.			AVERAGES FOR WEEK			
5	4.79833	.....	42.750	.....	.....	.....
12	4.78088	.....	42.750	.....	.....	.....
19	4.74365	.....	42.750	.....	.....	.....
26	4.76125	.....	42.750	.....	.....	.....

Calendar week averages: New York Silver, 1st, 42.750; 8th, 42.750; 15th, 42.750; 22nd, 42.750; 29th; 42.750.

(e) Not quoted; Saturday.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.325c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1938, the U. S. Government's price on newly mined domestic silver was established at 64.64c. Handy & Harman's quotation for domestic silver, 999 fine, was 64⅛ c. per ounce throughout October.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quotated by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1938	COPPER			TIN		LEAD				ZINC			
	Standard		Electro	Standard		Spot		3 months		Spot		3 months	
Oct.	Spot	3 months	Bid	Spot	3 months	Buyers	Sellers	Buyers	Sellers	Buyers	Sellers	Buyers	Sellers
3.....	42.3750	42.5000	47.5000	196.5000	197.5000	15.1250	15.1875	15.3125	15.4375	14.1250	14.1875	14.3750	14.4375
4.....	42.5625	42.7500	47.7500	196.0000	197.2500	15.0000	15.1250	15.2500	15.3125	14.1250	14.1875	14.3125	14.4375
5.....	43.0000	43.1875	48.2500	197.0000	198.2500	15.0625	15.1250	15.2500	15.3125	14.0000	14.0625	14.2500	14.3125
6.....	44.0000	44.1875	49.0000	202.2500	203.7500	15.8750	15.9375	16.1250	16.1875	14.6250	14.7500	14.8750	14.9375
7.....	44.1875	44.4375	49.5000	204.0000	205.2500	15.8125	15.9375	16.0625	16.1250	14.6875	14.8125	14.9375	15.0000
10.....	45.2500	45.4375	50.5000	207.5000	209.0000	16.1250	16.2500	16.3125	16.3750	15.0000	15.1250	15.2500	15.3750
11.....	46.1250	46.2500	51.2500	206.2500	207.2500	16.0000	16.0625	16.1875	16.2500	14.8750	15.0000	15.1250	15.1875
12.....	45.9375	46.1875	51.2500	205.2500	206.5000	16.0625	16.1875	16.3125	16.3750	14.9375	15.0625	15.1250	15.1875
13.....	46.6875	46.9375	52.0000	207.2500	208.2500	16.5625	16.6875	16.7500	16.8125	15.1250	15.2500	15.3125	15.3750
14.....	47.4375	47.6875	53.0000	209.0000	210.2500	16.8125	16.9375	16.9375	17.0000	15.4375	15.5625	15.6875	15.7500
17.....	48.3125	48.5625	53.7500	210.7500	211.7500	16.8125	16.9375	16.9375	17.0000	15.6875	15.8125	15.9375	16.0000
18.....	45.9375	46.1875	50.5000	207.0000	208.0000	16.3750	16.5000	16.4375	16.5000	15.4375	15.5000	15.5625	15.6250
19.....	46.8125	47.0625	51.7500	210.7500	211.5000	16.4375	16.5625	16.5625	16.6250	15.4375	15.5625	15.6250	15.6875
20.....	46.0625	46.2500	52.0000	208.7500	209.7500	16.2500	16.3750	16.3125	16.3750	15.2500	15.3750	15.3750	15.4375
21.....	45.5000	45.7500	51.5000	208.2500	209.2500	16.0000	16.1250	16.1250	16.1875	15.1250	15.2500	15.2500	15.3125
24.....	46.1875	46.4375	52.0000	210.7500	211.7500	16.1250	16.2500	16.3125	16.3750	15.3125	15.4375	15.3750	15.5000
25.....	46.3750	46.5625	52.5000	210.7500	212.0000	16.3750	16.5000	16.5000	16.5625	15.4375	15.5625	15.5000	15.5625
26.....	46.8750	47.1250	52.7500	212.0000	213.2500	16.6250	16.7500	16.7500	16.8125	15.4375	15.5625	15.5000	15.5625
27.....	46.7500	46.9375	53.2500	211.5000	212.5000	16.5000	16.5625	16.6250	16.6875	15.3750	15.5000	15.4375	15.5000
28.....	46.5625	46.7500	52.7500	212.8750	213.5000	16.4375	16.5625	16.5625	16.6250	15.2500	15.3750	15.3750	15.4375
31.....	45.6250	45.8125	52.2500	210.7500	211.7500	16.1250	16.1875	16.2500	16.3125	14.8750	15.0000	14.9375	15.0000
Average for month...	45.646	.....	51.190	206.911	.....	16.173		16.313		15.083		15.232	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Nov. 1, 1938)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb ..... 20c.
Antimony, domestic, spot, lb 12.250
Bismuth, ton lots, lb $1.05
Cadmium, lb ..... 65@95c.
Calcium, lb., ton lots 97 @ 98 per cent ..... 75c.
Chromium, 97 per cent grade, lb ..... 85c.
Nickel, electrolytic cathodes, lb ..... 35c.
Magnesium, 99.8 per cent, carloads, lb ..... 30c.
Palladium, troy oz $24.00
Platinum, (Official quotation) troy oz $37.00
Quicksilver, flask of 76 lb., 100 flasks or more ..... $72.00@$74.00
Radium, mg. radium content $40.00
Selenium, 99.5 per cent, lb $1.75
Silicon, minimum 97 per cent, spot, lb 16.50c
Tellurium, lb $1.75
Thallium, 100 lb. or more, lb $6.50
Titanium, 96 to 98 per cent, lb $5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton ..... $30.00@$35.00
Chrome Ore, 48 @ 50 per cent, c.i.f. Atl. ports, long ton ..... $22.00@$23.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:
Old Range bessemer $5.25
Mesabi bessemer $5.10
Old Range non-bessemer $5.10
Mesabi, non-bessemer $4.95
Lead (Galena) 80 per cent, Joplin, Mo., ton $57.98
Manganese Ore, c.i.f. Atlantic ports, long ton unit:
52 @ 55 per cent ..... 30c.
50 @ 52 per cent ..... 30c.
44 @ 48 per cent ..... 27c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2 ..... 45c.
Tungsten Ore, per unit of WO_3:
Chinese, 65 per cent, duty paid $20.50
Domestic, 65 per cent. and upward ..... (a)$18.00@$20.00
Vanadium Ore, per lb. of contained V_2O_5 ..... 27½c.
Zinc, Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton $33.00
(a) Prices at mines, small lots, usually several dollars less.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb 3c
Cobalt Oxide, 70 @ 71 per cent, lb ..... $1.67@$1.77
Copper Sulphate, 100 lb $4.50
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb $1.42
Sodium Sulphate, bulk, ton ..... $13.00@$15.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be $23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb ..... 10½c.
Ferromanganese, 78 @ 82 per cent, gross ton $92.50
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo contained. 95c
Ferrosilicon, 50 per cent, gross ton $69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained $1.60

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:
Canadian (Quebec)
Crude No. 1 ..... $700@$750
Crude No. 2 ..... $150@$350
Spinning fibers ..... $110@$200
Paper stock ..... $40@$45
Shorts ..... $12@$16.50
Vermont
Shingle stock $57
Paper stock $40
Cement stock $25
Barytes, long ton:
Georgia, crude $7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron ..... $6.00@$7.00
Bauxite, long ton:
Domestic, chemical, 55 @ 58 per cent ..... $6.50@$7.50
Domestic, abrasive, 70 @ 84 per cent ..... $12.50@$15.00
Dalmatian, 50 @ 55 per cent ..... (a)$6.50@$7.50
French, 56 @ 59 per cent ..... (a)$7.50@$8.50
China Clay, f.o.b. mines, ton:
South Carolina and Georgia, No. 1, bulk ..... $6.75@$8.00
Delaware, No. 1 ..... $14.50
Feldspar, bulk, ton:
Potash feldspar, 200 mesh $17.00
Glass-spar, white, 20 mesh $11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton $18.00
Fuller's earth, f.o.b. Georgia or Florida, ton ..... $7.00@$14.00
Magnesite, per ton:
Dead-burned, f.o.b. California $25.00
Dead-burned, f.o.b. Washington $22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:
1½ x 2 in ..... 15@40c.
2 x 2 in ..... 30@60c.
3 x 3 in ..... 75@$1.20
3 x 4 in ..... $1.00@$1.40
4 x 6 in ..... $2.00@$2.50
White, ground, 70 mesh, ton ..... $60.00@$80.00
Ocher, Georgia, ton ..... $19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports ..... (a) 12@12½c.
Silica, in bags, 325 mesh, ton ..... $18.00@$40.00
Sulphur, Texas mines, long ton $16.00
Talc, f.o.b. works, ton:
New York, double air-floated, 325 mesh ..... $12.00@$15.00
New Jersey, mineral pulp ..... $8.00@$10.00
Vermont, extra white, 200 mesh ..... $9.00@ $9.50
Tripoli, Missouri, ton:
40 mesh, cream colored $14.50
200 mesh, cream colored $26.00
(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:
Bessemer $21.50
Basic $20.50
No. 2 Foundry $21.00
Steel, base prices, Pittsburgh:
Billets, gross ton $34.00
Structural shapes, 100 lb $2.10
Bars, 100 lb $2.25

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1937	1938	1937	1938	1937	1938
January	44.913	44.750	20.734	19.895	490.670	499.895
February	44.750	44.750	20.083	20.159	489.307	501.722
March	45.130	44.446	20.677	20.088	488.412	498.394
April	45.460	42.750	20.740	18.880	491.524	498.046
May	45.025	42.750	20.346	18.731	493.835	496.673
June	44.818	42.750	20.022	18.945	493.404	495.772
July	44.750	42.750	19.986	19.356	496.582	492.855
August	44.750	42.750	19.848	19.389	498.043	488.044
September	44.750	42.750	19.889	19.300	495.145	480.240
October	44.750	42.750	19.942	19.613	495.395	476.785
November	44.750	.....	19.707	.....	499.467	.....
December	44.750	.....	18.835	.....	499.510	.....
Year	44.883	.....	20.067	.....	494.275	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1937	1938	1937	1938	1937	1938	1937	1938
January	12.415	10.198	12.112	9.908	51.497	41.387	56.288	45.387
February	13.427	9.775	13.828	9.525	59.225	39.597	64.013	43.563
March	15.775	9.775	16.590	9.496	72.339	39.772	76.167	43.582
April	15.121	9.775	14.692	9.443	62.506	39.306	66.614	43.408
May	13 775	9.375	13.999	8.801	61.118	36.668	63.684	40.852
June	13.775	8.775	13.492	8.500	55.696	35.235	61.409	39.417
July	13.775	9.585	13.817	9.573	56.412	39.744	62.807	44.405
August	13.775	9.900	13.926	9.844	57.143	40.591	63.595	45.909
September	13.530	10.028	12.984	9.943	52.989	41.864	58.966	47.148
October	11.838	10.760	11.207	10.713	45.384	45.646	50.619	51.190
November	10.797	.....	9.850	.....	39.321	.....	44.023	.....
December	10.006	.....	9.714	.....	39.946	.....	43.886	.....
Year	13.167	.....	13.018	.....	54.465	.....	59.339	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1937	1938	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	6.000	4.870	5.850	4.720	27.272	27.150	16.135	16.253
February	6.239	4.632	6.089	4.482	28.319	28.328	15.402	15.525
March	7.190	4.500	7.040	4.350	33.027	32.979	15.992	16.075
April	6.175	4.500	6.025	4.350	26.014	25.878	15.579	15.623
May	6.000	4.400	5.850	4.250	24.000	23.891	14.210	14.376
June	6.000	4.148	5.850	3.998	22.878	22.759	13.969	14.012
July	6.000	4.882	5.850	4.732	23.932	23.703	14.921	15.034
August	6.452	4.900	6.302	4.750	22.606	22.670	14.371	14.480
September	6.400	4.998	6.250	4.848	20.990	21.044	15.249	15.401
October	5.740	5.100	5.590	4.950	18.259	18.318	16.173	16.313
November	5.033	.....	4.883	.....	16.706	16.714	.....	.....
December	4.875	.....	4.725	.....	15.905	15.994	.....	.....
Year	6.009	.....	5.859	.....	23.326	23.286	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits New York		Standard, Spot London	
	1937	1938	1937	1938
January	50.925	41.548	229.350	183.619
February	52.010	41.373	233.750	183.144
March	63.043	41.219	282.988	183.473
April	59.172	38.430	267.136	168.612
May	55.651	36.885	250.645	162.693
June	55.851	40.376	249.852	177.429
July	59.245	43.428	263.540	192.542
August	59.465	43.276	264.595	192.966
September	58.675	43.369	258.943	193.733
October	51.654	45.263	223.869	206.911
November	43.299	.....	190.477	.....
December	43.051	.....	190.449	.....
Year	54.337	.....	242.133	.....

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	5.847	5.000	21.153	21.281	14.994	15.173
February	6.465	4.813	25.122	25.322	14.408	14.589
March	7.381	4.417	33.188	33.405	14.364	14.477
April	7.010	4.141	26.216	26.344	13.729	13.919
May	6.750	4.042	23.092	23.365	12.682	12.869
June	6.750	4.131	21.409	21.528	12.890	13.104
July	6.923	4.745	22.568	22.693	14.144	14.371
August	7.192	4.750	24.140	24.290	13.467	13.675
September	7.190	4.846	21.406	21.607	14.040	14.246
October	6.085	5.012	17.722	17.955	15.083	15.232
November	5.630	.....	15.808	15.970	.....	.....
December	5.010	.....	15.274	15.429	.....	.....
Year	6.519	.....	22.258	22.432	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1937	1938	1937	1938
January	90.000	117.500	19.500	20.000
February	90.000	117.500	19.500	20.000
March	101.667	117.500	20.000	20.000
April	105.000	102.500	20.000	20.000
May	105.000	102.500	20.000	20.000
June	130.962	102.500	20.000	20.000
July	142.500	102.500	20.000	20.000
August	142.500	99.722	20.000	20.000
September	142.500	84.000	20.000	20.000
October	142.500	80.000	20.000	20.000
November	142.500	.....	20.000	.....
December	132.888	.....	20.000	.....
Year	122.335	.....	19.917	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound, average of producer's and plater's quotations.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1937	1938	1937	1938	1937	1938
January	14.130	13.750	90.250	79.240	50.400	36.000
February	14.563	13.750	91.000	76.455	64.364	36.000
March	16.375	13.750	91.778	72.444	58.000	36.000
April	16.043	13.654	92.000	71.019	58.000	36.000
May	14.830	12.460	95.520	74.640	54.800	33.400
June	14.702	11.731	96.654	80.731	53.000	33.231
July	14.803	11.030	93.904	76.860	50.115	36.000
August	15.327	10.880	91.423	75.500	51.000	37.000
September	16.555	11.310	89.020	74 420	51.000	39.000
October	16.935	12.060	86.140	73.480	48.560	37.960
November	15.848	.....	83.435	.....	43.652	.....
December	14.144	.....	81.038	.....	38.385	.....
Year	15.355	.....	90.180	.....	51.773	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1937	1938	1937	1938	1937	1938
January	21.50	24.50	20.50	23.50	21.00	24.00
February	21.50	24.50	20.50	23.50	21.00	24.00
March	24.20	24.50	23.20	23.50	23.70	24.00
April	24.50	24.50	23.50	23.50	24.00	24.00
May	24.50	24.50	23.50	23.50	24.00	24.00
June	24.50	23.73	23.50	22.73	24.00	23.23
July	24.50	20.50	23.50	19.50	24.00	20.00
August	24.50	20.50	23.50	19.50	24.00	20.00
September	24.50	20.50	23.50	19.50	24.00	20.00
October	24.50	21.50	23.50	20.50	24.00	21.00
November	24.50	.....	23.50	.....	24.00	.....
December	24.50	.....	23.50	.....	24.00	.....
Year	23.975	.....	22.975	.....	23.475	.....

Iron in dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

Mauricio Hochschild has been in New York for the past fortnight.

Dallas Becker has returned from San Juancito, Honduras, to his home in Galesburg, Mich.

R. O. Hocking, formerly with Butler Brothers on the Mesabi range, is now at St. Paul, Minn.

Sydney H. Ball, of the firm of Rogers, Mayer & Ball, is in the West on a professional examination.

E. E. B. Sengier, managing director of Union Miniere du Haut-Katanga, arrived in New York on Oct. 25.

H. Rea Beckwith has changed his residence to Callao, Peru. Mail should be addressed him at Casilla 51, Callao.

H. F. Mills has been appointed general manager of Iron King Mining Company, Humboldt, Yavapai County, Ariz.

Thomas Bostwick is now with the Achotla unit of Cia. Minera de Peñoles, S. A., Balsas, Guerrero, Mexico.

L. C. Graton, professor of mining geology at Harvard, visited Waihi, N. Z., in August. He then went to Australia.

J. F. Thorn, general manager of Lake View & Star, Ltd., Kalgoorlie, is on a visit to Great Britain and the United States.

Robert Linton, consulting mining engineer of Los Angeles, has recently been engaged in examination work in eastern Utah.

R. W. Mancantelli, recently with Lake Shore Mines, is now mill superintendent of Stadacona Rouyn Mines, Ltd., Rouyn, Que.

Merle H. Guise has returned to the Olympic Hotel, Seattle, Wash., to complete his data on his prospecting enterprises in Alaska.

E. R. Borcherdt, after attending the American Mining Congress convention at Los Angeles last month, went to Arizona and Mexico to visit various properties.

L. G. Wilkins, of the metallurgical staff of Broken Hill South, Ltd., Australia, has been appointed mill superintendent of North Broken Hill, Ltd.

D. F. Johnson, formerly in Globe, Ariz., is now employed as a mill operator at one of the properties of Cia. Aramayo, Casilla, 674 La Paz, Bolivia, S. A.

Julius Kruttschnitt, managing director of Mount Isa Mines, Ltd., has been elected president of the Australasian Institute of Mining & Metallurgy for 1939.

N. Landau has left the Sherwood Starr Gold Mining Company, Que Que, Rhodesia, and is now with Rezende Mines, Ltd., at Penhalonga, Southern Rhodesia.

H. K. Shirrefs, mill superintendent for Electrolytic Zinc Company at Rosebery, Tas., is to join Lake George Mines, Ltd., Captain's Flat, N. S. W., as mill superintendent.

William P. Woodside, vice-president of Climax Molybdenum Company, was elected president of the American Society for Metals at the annual meeting held in Detroit, Oct. 20.

John Kanner, chief chemist for the Cuban Mining Company at Cristo, Cuba, has been in the United States on a month's vacation, during which he visited Nashville, Tenn., and New York City.

Dr. J. B. Tyrrell, pioneer in deep mining in the Kirkland Lake district of northern Ontario, recently visited some of the gold mines in the Little Long Lac area of northwestern Ontario.

E. J. Olson, who was in the engineering department of the Oliver Iron Mining Company at Ishpeming, Mich., has been transferred to Chisholm, Minn., as assistant mine superintendent of that district.

J. O. Greenan, consulting engineer during the past five years for Marsman & Company, has established headquarters in Mill Canyon, Lander County, Nev., where he is operating a gold property.

C. W. Nicolson, formerly general mine superintendent of the Eagle-Picher Mining & Smelting Company, has accepted the position of general superintendent with the Isle Royale Copper Company at Houghton, Mich.

Charles Bocking, of Vancouver, B. C., long identified with Granby Consolidated, has been made vice-president and general manager of the Alaska Steamship Company, which conducts freight and passenger service.

Theodore Pilger, who has spent the past two years on engineering and financial work in various European countries, has returned to the United States on a short business trip. He can be reached through Armco International Corporation, 21 West St., New York City.

H. E. McKinstry, consulting geologist, is examining the Columbia, Eureka-Excelsior and North Pole properties in the Cracker Creek mining district near Sumpter, Oregon, and other properties in Grass Valley, California, for the Campbell Mining Company, Inc., of New York.

Louis Shattuck Cates, president of Phelps Dodge Corporation, was on Oct. 17 designated by the board of directors of the A.I.M.E as a William Lawrence Saunders medalist in recognition of his achievements in the development of large-scale methods of mining copper ores and as an administrator of mining and metallurgical enterprises.

S. Frank Hunt, geologist-prospector who discovered and developed the Rio Tinto mine of the Mountain City Copper Company in northern Elko County, Nev., has closed his Salt Lake City office and, in company with his former secretary, **Fred C. Gebhart,** has established headquarters at Carson City, Nev.

Medley G. B. Whelpley has been elected president of the Pacific Tin Corporation, succeeding Silas W. Howland, deceased. Mr. Whelpley is a partner in Guggenheim Brothers, a director of Kennecott Copper, and president of Anglo-Chilean Nitrate Company, Ltd., and Lautaro Nitrate Company, Ltd. Pacific Tin controls the Yukon Pacific Mining Company.

▼

OBITUARY

Douglas Gray, pioneer Western mining engineer, died in Tucson, Ariz., on Oct. 13. He was 83 years old.

A. S. Howie, general manager of Trepca Mines, Ltd., and associated Yugoslavian mining enterprises, died Sept. 23.

Marvin A. Williams, 46 years old, chief engineer of Nevada Consolidated's steam-electric plant at Hayden, Ariz., died in that city on Oct. 9.

Charles C. Ross, Minister of Lands and Mines of the Alberta Government from 1935 to 1937, died in Vancouver, B. C., on Sept. 12 at the age of 54.

Preston Locke, of Pasadena, Calif., resident engineer for the American Smelting & Refining Company, was drowned at Vancouver, B. C., on Oct. 6.

Dr. Forrest Alexander Kerr, since 1924 of the staff of the Geological Survey of Canada, was killed in a motor accident on Aug. 2 last. He was 42.

Max Koeckert, general manager of the plant of United States Metals Refining Company at Carteret, N. J., and his wife, Ella, were killed in a motor accident on Oct. 23. He was 54.

H. H. Schlapp died at his home in Melbourne on Sept. 8 at the age of 84. Born at Fort Madison, Iowa, in 1854, Mr. Schlapp came from Pueblo, Colo., in 1886, to join the staff of the Broken Hill Proprietary Company, and built the first smelters at Port Pirie, South Australia. Later he was prominently associated with development of Mount Lyell.

Van Dyne Howbert, chief field mining engineer for the American Metal Company of New York, died on Oct. 13 at the age of 46. Mr. Howbert was an alumnus of Sheffield Scientific School and the Colorado School of Mines. He served in France during the World War as a first lieutenant with the 314th Engineers. He had been vice-president and director of the American Metal Company of Texas and also a director of the American Metal Company of New Mexico and the American Metal Company of Canada, Ltd. During his eighteen years with the American Metal Company he traveled extensively in its behalf in the United States, Mexico, Canada, and South America. With Mr. Howbert's ability as geologist and engineer, and his excellent business judgment, there

were combined a winsome frankness and a kindly, cheerful nature that caused him to be held in affectionate regard by his associates, by those who worked under him, and by all his friends in the profession.

Messrs. Root and Simpson

An Appreciation

In the September issue of *Engineering and Mining Journal* I note with deep regret the obituary notice of my good friend, William P. Simpson, junior member of the firm of Root & Simpson, assayers, Denver, Colo.

For the past five years, since the death of his partner, John William Root, Mr. Simpson had been carrying on the work of Root & Simpson. Now, both members are gone, and I feel that every mining man, as well as the mining industry as a whole, owes a vote of tribute to these two fine men. It is not very often that the assayer or chemist attains prominence in his profession, yet what would the mining and metallurgical business be without men of the type of Messrs. Root and Simpson?

John William Root was a graduate of the University of Kansas in 1888, with a degree of Ph. G. He was a member of Sigma Chi Fraternity. For many years, up until the time of its closing, Mr. Root was assayer at the Philadelphia plant of the American Smelting & Refining Company at Pueblo, Colo. With the closing of that plant, he and another member of the Philadelphia plant laboratory staff, William Leonard, opened a custom assay office in Denver under the name Leonard & Root. The office was run by Mr. Root, as Mr. Leonard continued his work with the American Smelting & Refining Company in Salt Lake City for a good many years after the opening of this office.

During my high school days in Denver, I was obliged to spend my summer and end-of-the-week vacations in the assay office of my father, the late Stephen Rickard. One summer, I had the good fortune to secure employment in the office of Leonard & Root. Mr. Root drilled me so thoroughly in his careful, conscientious, and utterly honest methods, that I never forgot what I had been taught. These lessons served me well when, some years later, I secured my first job with the American Smelting & Refining Company as assistant assayer at the Monterrey, Mexico, plant, and found that the head assayer, my boss, was William P. Simpson. He and I immediately noticed that each followed practically the same methods, which explained itself later when we learned that each had received his early training under the direction of John W. Root, Mr. Simpson having worked under him at the Philadelphia plant, prior to his employment at Monterrey. Later, Mr. Simpson left Mexico and associated himself with Mr. Root, after Mr. Leonard retired from the firm.

For many years, this firm of Denver assayers has been held in the highest esteem by all mining men and mining companies; and I am sure that it is with deep regret that all of us note the passing of these two fine men, who have contributed their share toward the success of mining in the West.

BRENT N. RICKARD

El Paso, Tex.

A LETTER

Dust-count Data With Dry Drilling and Ventilation

The Editor:

IN YOUR ISSUE for September, 1938, Messrs. Kelly and Brackett, referring to our article "Some Dust-count Data Derived With Wet Drilling," have questioned some of our data as well as the conclusions.

Before proceeding to a general discussion of their comments, may we make it clear that the paper was essentially a presentation of results obtained with wet drilling, and only incidentally a discussion on the relative merits of the exhaust system. The results published were those obtained with the dust collectors operating under normal working conditions, and did not include a few obtained under extremely favorable conditions. No doubt good results are obtained by the exhaust systems when used under conditions favorable to their operation, but unfortunately such conditions are not representative of subway and tunnel work in the New York area.

Commenting specifically on Messrs. Kelly's and Brackett's references to the data in the article:

The statement is made that the contractors do not want to accept the rules and regulations of the State Department of Labor. The contractors have at all times shown a sincere desire to meet effectively the requirements of the law and by doing so were compelled to eliminate the system of dry drilling with dust trap under the prevailing conditions of operation. Wet drilling was one of the methods approved by the industrial code governing the New York Silicosis Act, effective May 1, 1937. Since then a code of rules governing the operation of wet drilling has been approved and is now in effect.

In regard to the claim that the article offered material derogatory to dry drilling dust control, may we reiterate that the article pointed out the ineffectiveness of dry drilling as applied to the type of work being conducted by the New York contractors; but we specifically stated that the exhaust system did have a definite function in certain types of work.

As to the matter of deducting the "ambulant" air, this was done at the request of the manufacturers of the dry dust collectors. They claimed that dust present in the air prior to drilling, or at a distance of 20 to 25 ft. from the immediate working area, could not be attributed to the drilling, and should, therefore, be deducted from the gross dust count. The plea was granted by the State, and our tests were made accordingly. In spite of this concession, however, in all our experiments using the wet method, the aim was to obtain a gross count below the permissible limit. An inspection of the published data will show that such counts were generally obtained.

In the official test of Nov. 17, 1937, referred to, the data were not published, because the operation was conducted under ideal conditions and naturally should show good results. They were not at all representative of usual working conditions. With reference to the official test at 53d St. on Nov. 9, the bench on which the drilling was conducted did not consist of a foot of soupy mud and eighteen inches of disintegrated hardpan overlying the schist, as claimed. Rather, the drilling was done on a hard, dry rock bench, and wet rock was encountered after a few feet of penetration. The actual over-all speed as determined by a careful check was two inches per minute, as we stated in our article. The drillers were not to blame for the stuck steel, since they were regular and competent drill runners working under supervision of the dust collector manufacturers, who were present at the test.

As to the contention that the drillers were not visible at the top of the Walsh shaft when drilling wet, we do not recall that any such condition ever existed; and as to expressing doubt regarding our claim that equally good results were obtained with wet drilling as dry drilling in this same shaft, the results published in the article in Table II are sufficient proof. We have additional data to back up this statement.

The failure of the dust collectors in the tunnel heading requires no further remarks to those expressed in the article, except to state that the equipment was removed from the Walsh tunnel at the express request of the manufacturer after it had received a fair trial. It was frankly admitted that the method was impractical.

In conclusion may we say that the entire controversy of wet verus dry drilling strikes us as being pointless. We have no axe to grind in so far as either method is concerned. We are, however, vitally concerned with the problem of effectively eliminating the dust hazard, and, as such, we are opposed to any dogmatic assertions as to the general inclusiveness of any one method. The main point is that circumstances should dictate the method of control and not the reverse. If a contractor finds conditions suitable for the use of dust collectors and elects to use them he should do so. But if conditions are such as to dictate the use of wet drilling, and he is able successfully to control the dust in that manner, he should by all means be permitted to do so. The main thing is to get rid of the dust in the most efficient, economical, and practical manner.

It is to the credit of the New York State Industrial Commission that its members have taken a similar view of the matter. The existing code permits either wet or dry drilling, and definite rules governing both methods have been adopted. With such a farsighted program and with continued cooperation between the Commission, the contractors, and the equipment manufacturers, it will not be long before the dust hazard will be well under control.

May we add a correction to the article as published. On the last page the heading "Standards for the Testing of Wet Drilling Equipment and Methods of Dust Control" should read: "Code of Rules Governing the Operation of Wet Drilling."

PHILIP S. MILLER
FREDERICK B. FLINN.

New York, N. Y.

What Metal Statistics Show

THE MARCH BACK to the mines continued during October and early November, as producers recalled around three thousand more men for work. Statistics of copper, lead, and zinc continue in a very good position, but the remaining months of the year will reflect rising production of all three metals, bringing them into better balance with consumption. The outlook for the automobile, building, and utility industries, and for business in general, continues favorable and the non-ferrous industry seeks to have sufficient metals on hand for anticipated demand and also to avoid the occurrence of unwieldy market conditions that prevailed early in 1937. Among copper mines that have recently reopened are the Leonard and St. Lawrence mines of Anaconda Copper, the Mountain City copper mine, in Nevada; the Walker mine, in California, and the Chino unit in New Mexico of the Nevada Consolidated Copper Corporation. Copper smelters recently reopened are those in Tooele, in Utah, and Hayden, Ariz. The strike at the East Helena lead smelter was settled and operations were resumed Oct. 31. There is more activity in the Tri-State zinc mines and the zinc smelter of the Eagle-Picher Lead Company, at Henryetta, Okla., will resume production on Nov. 15.

Copper deliveries to consumers are expected to reach a substantial high for October and another reduction in domestic stocks is anticipated.

Following is a summary of the figures of the Copper Institute for August and September:

	Aug.	Sept.
Production, blister:		
U. S. mine	36,420	41,051
U. S. scrap, etc.	8,138	8,695
Foreign mine	89,544	83,095
Foreign scrap, etc.	16,291	14,615
Totals	150,393	147,456
Production, refined:		
U. S. duty-free	38,053	45,808
Foreign	110,855	108,057
Totals	148,908	153,865
Deliveries to customers, refined:		
U. S. domestic	48,071	53,637
U. S. export	14,761	14,282
Foreign	114,748	123,016
Totals	177,580	190,935
Stock at end, refined:		
United States	315,191	293,080
Foreign	179,333	164,374
Totals	494,524	457,454

▶ LEAD—Production during October is expected to increase, but shipments to consumers will probably show a new high for the year.

The August and September figures on refined lead, in short tons, are summarized as follows:

	Aug.	Sept.
Stock at beginning	155,631	142,868
Production:		
Domestic ore	23,723	24,994
Secondary and foreign	1,824	2,514
Totals	25,547	27,508
Domestic shipments	38,343	39,026
Stock at end	142,686	131,353

Stocks and domestic shipments for May, June, July, and August have been revised, according to the American Bureau of Metal Statistics, and the following table contains the corrected figures:

	Shipments	Stock At End
January	34,923	133,401
February	30,135	138,134
March	31,052	143,511
April	25,952	156,715
May	25,098	164,636
June	35,048	164,554
July	40,409	155,631
August	38,343	142,868
September	39,026	131,353

E. & M. J. Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922-3-4)

1920	130.92	1929	110.33
1921	80.80	1930	82.87
1922	93.94	1931	60.20
1923	103.43	1932	48.26
1924	102.63	1933	59.79
1925	111.74	1934	69.56
1926	107.74	1935	74.66
1927	97.54	1936	73.45
1928	99.78	1937	90.86

	1936	1937	1938
January	72.25	87.03	75.56
February	71.65	91.68	73.43
March	71.90	103.78	72.41
April	72.27	98.62	71.19
May	72.51	93.25	69.15
June	72.02	93.21	67.55
July	72.18	93.82	72.95
August	72.70	95.28	73.94
September	73.01	94.33	74.70
October	73.22	85.26	77.61
November	77.19	78.91	....
December	80.50	75.18	....

The above *E.&M.J.* weighted index of non-ferrous metal prices shows the steady moderate rise from the low in June this year of 67.55 to 77.61 for October.

▶ ZINC—The September and October statistics of the American Zinc Institute, covering all grades, are summarized as follows in short tons:

	Sept.	Oct.
Production	32,328	36,740
Production, daily rate	1,078	1,185
Shipments	43,582	43,355
Stock at end	130,743	124,128
Unfilled orders	40,435	40,736

Statistics of the Prime Western division, common grades only, for September and October, follow:

	Sept.	Oct.
Stock at beginning	57,529	52,210
Production	14,167	15,833
Shipments	19,486	17,911
Stock at end	52,210	50,132

During October stocks covering all grades of zinc declined 6,615 tons. Of this total 2,078 tons was in Prime Western and the balance of 4,537 tons was in High Grade.

Gold Production of the World 1937-1938

American Bureau of Metal Statistics

(Thousands of Fine Ounces)

	Apr.	May	June	July	Aug.	Sept.	Jan.-Sept.
United States (a)	352	392	363	473	467	477	3,572
Canada	368	381	391	421	412	400	3,451
Mexico	68	53	86	121	*70	*90	731
Colombia	48	36	39	50	43	*44	376
Chile	20	22	25	21	*22	*23	199
Other America	72	74	72	72	71	71	642
Rumania	10	12	13	12	*12	*12	112
Other Europe (b)	34	33	34	38	38	38	310
British India (c)	26	27	26	25	27	27	239
Japan (d)	*60	*60	*65	*65	*65	*65	560
Other Asia (b)	90	94	95	100	100	100	849
Queensland	12	12	13	12	13	13	108
Western Australia	95	92	97	94	100	102	852
Other Australia	29	30	30	30	32	32	261
New Guinea	17	17	21	21	22	23	170
New Zealand	13	11	13	13	14	14	116
South Africa	981	1,023	1,015	1,036	1,046	1,035	9,067
Belgian Congo	38	38	36	36	38	36	337
Rhodesia	68	69	68	69	69	69	612
British West Africa	60	62	60	60	60	60	538
Other Africa	35	40	40	40	45	43	342
Totals ex Russia	2,496	2,578	2,602	2,808	2,766	2,774	23,444
Totals ex Russia previous year	2,374	2,497	2,486	2,545	2,636	2,520	22,146

* Conjectural. (a) Includes Philippines. (b) Exclusive of Russia. (c) Principal mines only, but nearly complete. (d) Owing to governmental interdiction, the accounting for Japan is now necessarily on the assumption that it is being maintained at about the prior rate.

CALIFORNIA

Operations Will Resume At Walker Mine

California's copper producer in Plumas County to be reopened soon—Properties near Nevada City optioned by Minnesota interests—Bids called for Narrows hydraulic debris dam

▶ Directors of Walker Mining Company recently announced that work would be started at the property during November. The mine was closed in May, and production is expected to reach capacity soon. About 450 men will be employed. Preference in hiring will be given to former employees. L. F. Bayer is manager.

▶ A cyanide plant to treat flotation concentrates and tailings may be installed soon by the Middle Fork Gold Mining Company at its Sliger mine, near Georgetown, El Dorado County. Production is around 100 tons a day, and 65 men are employed under the direction of C. W. Plumb, superintendent.

▶ According to a report from Nevada City, exploration has started on 1,200 acres of mineral properties lying in the eastern section of the Grass Valley-Nevada City mining area between holdings of Idaho Maryland Mines Corporation and Lava Cap Gold Mining Corporation by the H. C. Dudley interests, of Duluth, Minn. Properties optioned include the Banner Mountain claims owned by Charles H. Taylor, of Grass Valley, and mineral holdings belonging to Mrs. Maude I. Clark, of Salt Lake City. In addition, negotiations are reported to be in progress for the Penrose tract, consisting of 600 acres east of the Idaho Maryland mine. J. M. Boutwell is geologist of the company, and George E. Gallagher, with headquarters at Grass Valley, is superintendent.

▶ The New Idria Quicksilver Mining Company, of San Francisco, is producing from the Idria mine, San Benito County, around 450 flasks of quicksilver a month, with two rotary furnaces in operation handling 200 tons of ore a day. Ore is obtained both from underground mining operations and from old dumps. Preliminary treatment includes screening, jigging, and sluicing over riffles. Development work is also carried on at the adjoining San Carlos mine. The property is operated by the New Idria Quicksilver Mining Company, of San Francisco, with H. W. Gould, general manager. About 125 men are employed under C. Hyde Lewis, superintendent.

▶ Extensive development is in progress at the Gold Point mine, near Sierra City, Sierra County, operated by the Tombstone Development Company, of Arizona. William Porri is in charge, and about 30 men are employed.

▶ Bids for the construction of the Narrows hydraulic débris dam on the Yuba River near Smartsville will be called for in November by the United States Army Engineers in Sacramento, as plans and specifications for the second of three débris dams have been completed. Bids for the third unit, the Ruck-A-Chucky dam, are expected to be deferred until late December, as additional studies of rock formations are necessary.

▶ Exploratory work has been resumed with a small crew in the Norambagua mine, near Grass Valley, shut down recently by the Campbell Grass Valley Mining Company after nearly two years of continuous operation. The new activities are directed by George W. Worthington, general manager.

▶ Keystone Mine Syndicate, operating the Keystone and South Spring Hill mines, near Amador City, has opened and retimbered the main shafts at these properties to a depth of 900 ft., and is rapidly completing the 1,500-ft. tunnel to connect both shafts. Good progress is also being made in the construction of a 200-ton plant. T. S. O'Brien is in charge of operations.

▶ A new 65-ton flotation plant has recently been completed by the Black Hills Mining Company at the Italian mine, near Drytown, Amador County. Milling machinery includes a 5 x 5-ft. ball mill with a mechanical classifier, and Fagergren flotation cells. W. Tatum is president of the company.

▶ The old Mack mine, east of Nevada City, is being reopened by Denver interests, and dewatering operations are now in progress preparatory to examination and further development of the property. J. L. Jackson directs the work.

▶ Operations have been resumed at the Columbus mine, near Tuolumne, after eleven former employees obtained a lease from the owner, the Columbus Gold Mining Company. The property now is worked on a cooperative basis, with development work carried on on four levels and about 25 tons being milled daily.

MONTANA

Leonard and St. Lawrence Mines Reopened in Butte

Five properties of the Anaconda Copper Mining Company have resumed operations since Sept. 1—Production begins at East Helena lead smelter following settlement of four month strike

▶ On Sept. 24, the Anaconda Copper Mining Company reopened the Mountain Consolidated copper mine, at Butte, followed by resumption of operations at the St. Lawrence mine on Oct. 13 and the Leonard mine was reopened early in November. These properties are respectively the third, fourth, and fifth copper mines to resume operations since Sept. 1, the Steward having been opened on Sept. 6 and the Belmont on Sept. 18. The Anselmo mine was operated throughout the summer. When all these units have reached a full production rate, the total employment on the Butte Hill is expected to approach nearly 6,000 men. Attendent employment at the Rocker and Bonner timber framing mills, together with increases in the refining units at Anaconda and Great Falls, will be proportionately increased.

▶ The strike at the East Helena lead smelter of the American Smelting & Refining Company was settled recently and operations were resumed on Oct. 31. The plant had been shut down since July 6 of this year.

▶ It is expected that the new floating dredge now being assembled below Helena at Eldorado Bar, on the Missouri River, will begin work next spring. The Perry-Schroeder Mining Company, which recently was granted an R.F.C. loan of $250,000, will operate the placer deposit.

▶ It is reported that the dry-land plant recently operated in the Rocker district by Winston Brothers is being moved to an unexploited area on Prickly Pear Creek. Winston Brothers company is operating its new floating dredge near Alhambra Hot Springs, on Prickly Pear Creek.

▶ According to a recent announcement in Helena, the Atlas mill, in the Bald Butte mining district, which has been idle for several years, will be dismantled and shipped to Colorado.

▶ Although an early heavy snowfall has already made its appearance, M. I. Leydig reports that operations at the Atlantic and Pacific mine, near Pony, will be continued as long as weather permits. Last year, severe conditions during several weeks compelled a temporary shutdown of the mill.

▶ On Oct. 15, the Montana Section of the American Institute of Mining and Metallurgical Engineers met at Great Falls as the guest of the Anaconda Copper Mining Company at the ACM Clubhouse. H. M. Doran, superintendent of the electrolytic zinc plant, gave a paper in which he outlined all steps in the processing of 99.99 per cent pure zinc. H. J. Rahilly, assistant general superintendent of Anaconda mines, presented a comprehensive discussion of mine fires; their causes, methods of fighting, and preventative measures. He said work in the fire-fighting division of the Butte mines is directed toward prevention of fires by regulating rate and direction of ventilation, sealing off mined-out areas, and slime-filling many gob areas. He stated he has encountered no fires owing their origin to incendiarism, but faulty electrical equipment and spontaneous combustion were the greatest danger. Carbide lights are not used in the Butte mines.

▶ On Oct. 31 and 22 the Montana Society of Engineers held its 51st annual meeting at Bozeman. W. H. Hoover, Western general counsel, Anaconda Copper Mining Company, made an address at the annual banquet, at which Dr. A. L. Strand, president of the Montana State College, presided. G. G. Griswold, of Butte, was elected president for the coming year.

▶ The Branagan gold mine, in Lincoln County, is under lease and option to W. R. Wade and San Francisco associates, who have rehabilitated the mine, with production now under way. Ore is mined from a vein 7 to 12 ft. wide and trucked to the mill 8 miles distant. Mr. Wade has moved his office from San Francisco to Libby, Mont.

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UTAH

Smelting Operations Begin at Murray and Tooele

Higher lead and copper output from mines boosts activity—C.I.O. union fails to obtain majority at election of Utah Copper employees

▶ Operations were resumed at the Tooele copper smelter of the International Smelting Company on Nov. 7, to treat shipments of concentrate from the Mountain City Copper mine, at Rio Tinto, Nev., and other properties. Announcement of the resumption at the Tooele smelter, which means employment for 150 men, and the Nevada property was made by C. F. Kelley, president of the Anaconda Copper Mining Company, during a brief visit to Salt Lake City on Oct. 25.

▶ The lead smelter of the American Smelting & Refining Company at Murray started operations of one furnace following a shutdown on Oct. 26. William J. O'Conner is manager. About 300 men will be employed.

▶ Signing of an agreement between the International Smelting Company and the Tooele local of the International Union of Mine, Mill and Smelter Workers recently gave the first indication that the long deadlock between employers and employees is near an end. Months of negotiation finally resulted in an agreement that was approved both by Utah mine, mill and smelter operators and by a referendum vote of employees, but the executive board of the International Union refused its permission to sign the contract. A hurried attempt was made to patch up this difference, and the signing of the contract by the International Smelting Company and its employees indicates that perhaps one by one mining companies and union members will reach an accord. The action of the executive board of the International Union of Mine, Mill and Smelter workers is believed by many to have caused the defeat of the union in its battle to have Utah Copper Company employees of the Magna and Arthur mills designate the organization as sole collective bargaining agent. In an election last August, the vote was so close as to be indecisive and the National Labor Board ruled that the union did not have a majority of all ballots cast. On Sept. 22, the International Union was repudiated by a 2-to-1 majority in the second election held to determine a bargaining agency. Out of 950 votes cast, 666 were against and 282 in favor of C.I.O. affiliation. Two ballots were voided. The second election was held to be a decisive victory for the Independent Association of Mill Workers, which though not named on the ballot was competing with C.I.O. as the agency for collective bargaining.

▶ The second drill hole to strike a dry formation ahead of the bore of the Elton tunnel, near Tooele, gives officials reason to believe that by turning the line of drilling to the south, a more favorable formation can be reached for future work. After drifting last spring had opened up a heavy flow of water, officials stopped operations. Churn drilling was started to explore the formation.

▶ Retimbering of the Mayflower tunnel, preparatory to driving ahead again for main objectives, has been started by the New Park Mining Company in the East Park City district. A good-sized orebody, containing gold, silver, lead, and zinc, has been struck in the Park Galena shaft. The Mayflower tunnel will be advanced to explore this discovery at a depth 400 ft. vertically below the present discovery. While driving the tunnel, the company will continue sinking the shaft on the new ore showing. W. H. H. Cranmer, president of the company, also announces that the company will begin development of the Gold Queen group, in the southwestern part of the property. A 600-ft. tunnel and a shallow shaft have been cleaned out preliminary to starting development.

▶ Utah Copper Company's new vehicular tunnel leading from lower to upper Bingham will be open to traffic on or about Nov. 15. Finishing touches are being put on the big 6,000-ft. bore and the concrete work is being completed.

NEVADA

Mountain City Copper Mine Reopens

Property shut down since May 27 resumed operations on Nov. 1—Consolidated Coppermines' drilling program indicates additional ore in Morris Brooks area

▶ Directors of the Anaconda Copper Mining Company authorized J. O. Elton, manager for the International Smelting Company and president of its subsidiary Mountain City Copper Company, to resume operations on Nov. 1 of the latter company's Rio Tinto mine and 500-ton flotation mill at Mountain City, Elko County, employing about 300 men.

▶ Consolidated Coppermines Corporation, operating through the Emma Nevada shaft at Kimberly, paid a dividend of 12½c. per share on Oct. 15, having paid a similar amount in April. Mining operations are reported to have been proceeding at full capacity—namely, 6,000 tons per day—since the latter part of July. Production has been increased from a low of 124,000 tons per month in April, to more than 180,000 tons monthly, which is approximately the maximum allowed Consolidated Coppermines under the contract with Kennecott. Production of copper has recently been about 3,800,000 lb. monthly. A program of drilling started in May under the new management, employing churn and rotary drilling, has indicated an important additional tonnage of ore in the Morris Brooks area. It is planned to continue this program. A rotary drill to explore porphyry copper ores is a departure from customary practice of churn drilling, and to date the company is reported to have found this method successful. Boudinot Atterbury is president, P. L. Carret vice-president, J. B. Haffner general manager, J. Richards mine superintendent, Paul Sirkegan assistant mine superintendent, E. Pennebaker chief geologist, John Eaby chief clerk, and R. D. Hoffman consulting engineer.

▶ Contracts have been awarded by the Consolidated Chollar, Gould & Savage Mining Company for immediate construction of a 400-ton cyanide addition to its flotation mill at its Overman mine, on the Comstock lode, below Gold Hill. The flotation mill has been treating around 400 tons per day of low-grade ore, partly from old dumps. High-grade mill ore has been opened in late months in extending an old tunnel, and crosscuts are being driven from the main shaft, down to the 700-ft. point, to reach this ore near the footwall of the lode. Thomas V. Barton, of San Francisco, is managing director and F. V. Dempsey is superintendent.

▶ In the Federal court at Carson City, Judge F. H. Norcross has approved the proposal of James M. Leonard, trustee in Federal bankruptcy for the Arizona Comstock Corporation, to grant an option to William N. Albee, of Detroit, to purchase the assets of the corporation for $620,000, the amount of current liabilities, including delinquent payments on account of the purchase price of the properties, the Savage, Hale & Norcross, Chollar and Potosi mines on the Comstock lode at Virginia City. The mines were acquired under long-term payments from the Sutro Tunnel Coalition, Inc., J. M. Leonard president and manager, wholly-owned subsidiary of the Comstock Tunnel & Drainage Company. A force of 25 men has been engaged in sampling the mine and impounded tailing under direction of R. D. Gardner, who has recommended full-scale operation of both surface and underground mines, equipment of the flotation mill for cyanidation, and enlargement of the tailing cyanide plant.

▶ Construction of an all-steel dredge has been completed on placer claims of the Manhattan Gold Dredging Company under the direction of engineers of the Natomas Company of California. The dredge is the largest ever built in Nevada, with a reported capacity of 10,000 to 14,000 cu.yd. per 24-hour day. Water for floating the 180x60-ft. boat is brought by a newly laid 7-mile pipe line.

▶ A second zinc calcining furnace has been installed by the Grand Deposit Consolidated Mines Company at its mine 30 miles northeast of Ely, in White Pine County. Shipments of three carloads of Calcined zinc weekly to the Western Zinc Oxide Company are to be increased in volume. Paul C. Lyon, Atlas Building, Salt Lake City, is president and George H. Taylor, of McGill, Nev., manager.

▶ A second diesel power unit and 1,200-g.p.m. pump have been provided by the Gray Rock Mining Company, an operating subsidiary of the Newmont Mining Corporation, at a shaft sunk 350 ft. by the Elkoro Mines Company at Jarbidge. When shaft sinking, a heavy flow of water was encountered at 500 ft., and work was suspended. With pumps installed sinking will continue to the 900-

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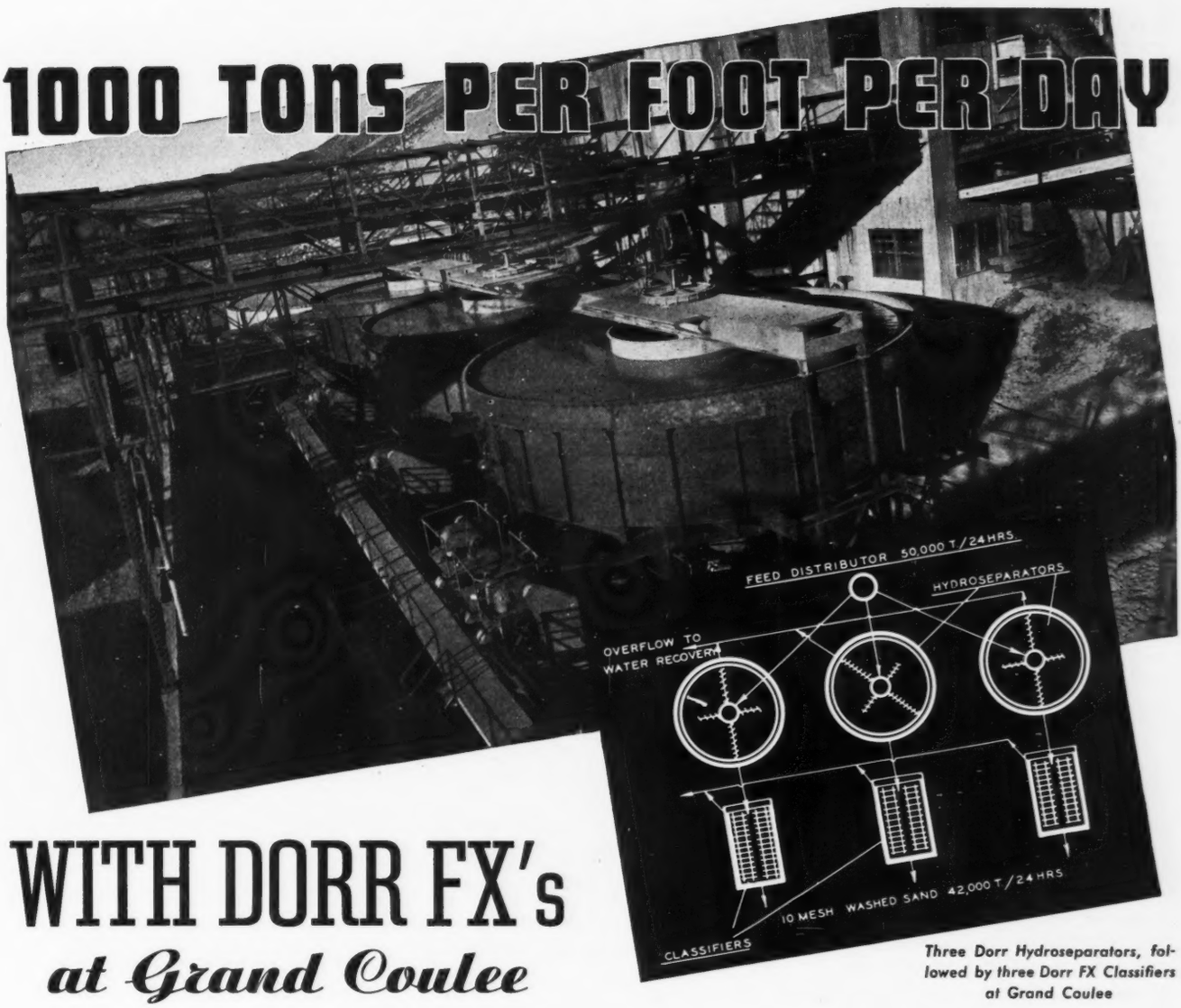

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▶NEVADA

ft. point, where gold ore is said to have been penetrated by diamond drills. R. O. Camozzi is the directing engineer in charge of operations at Jarbidge.

▶ A dividend at the rate of 5c. per share was paid on Oct. 26 by the Getchell Mine, Inc., the second payment of like amount within two months. An interest reputedly between 25 and 30 per cent is owned by the Newmont Mining Corporation, which is said to have provided funds for construction of the cyanide mill and ore-roasting plant, now treating around 700 tons per day. Gold bullion is shipped to the United States mint at San Francisco. Noble H. Getchell is vice-president and manager and Roy A. Hardy is consulting engineer for the company.

▶ In the Pioche district the Combined Metals Reduction Company is shipping from 1,200 to 1,500 tons of lead-silver ore weekly to its reduction plant at Bauer, Utah. From the station at the 1,200-ft. level of its main Caselton shaft, the company is driving a crosscut 8x8 ft. in the clear to connect with the No. 1 mine shaft, over 4,000 ft. distant. E. H. Snyder is general manager of the company, with offices at Stockton, Utah.

IDAHO

New Production Record At Sunshine Mine

Company treated 84,415 tons of ore during third quarter—Shaft sinking at Polaris will continue to 2,300-ft. level

▶ The Sunshine Mining Company, at Kellogg, reported a profit of $1,033,433 for the third quarter of the current year. Dividends paid out totaled $893,292.60, according to R. B. Kenyon, mine auditor. An average of 918 tons of ore were milled daily during the quarter, according to R. D. Leisk, manager, setting up a new production record for the mine. September's production of 31,410 tons of ore was responsible for the new record. During the quarter over 3,000 ft. of development work was done, of which 1,735 ft. was in ore.

▶ Operations at the Palisade mine, located 6,000 ft. high in the Pine Creek district, have been suspended for the winter because of heavy snowfall late in October. Theodore Schmidt, of Coeur d'Alene, is manager.

▶ Crystal Springs Mining Company, near Lane, recently acquired complete shaft-sinking equipment, according to Luther G. Evans, of Cataldo, president. Operations will be continued throughout the winter.

▶ Mineral Mountain Company has its shaft down 165 ft., according to Lafe Morris, of Kellogg, superintendent. The vein opened on the tunnel level will be cut at 225 ft. by the vertical shaft.

▶ Sonora Mining & Milling Company stockholders have elected C. H. Swanson of Burke, president; Felix Daigle of Wallace, vice-president; George L. Richardson of Wallace, secretary; and Charles Olsen of Burke, Stella Richardardson, Albert Hausaman, and Charles Gleim of Wallace, directors.

▶ Red Ledge, Inc., owner of an extensive low-grade gold-copper property in the Seven Devils district of Adams County, has resumed negotiations seeking to finance driving of a tunnel to develop the property. William H. Simons, of Boise, former State mine inspector, is president and Elmer W. Fox, of Boise, secretary-treasurer.

▶ The Coeur d'Alene Mines property was the scene of an ore strike when the crosscut from the 1,000-ft. level encountered a vein showing siderite containing silver and copper. This vein has puzzled engineers, as it is not the main vein sought by the deep crosscut, estimated to be some 100 ft. ahead of the present face.

▶ Anchor mine, in the Murray district, recently shipped a car of high-grade lead-silver ore to the Bunker Hill smelter at Kellogg, according to John George, of Kellogg, manager. Plans are now under way to install jigs and other milling equipment at the mine, where several hundred tons of ore have accumulated during development operations. The ore-body in the upper tunnel level is 12 ft. wide in places, Mr. George reported.

▶ Polaris Mining Company is sinking an additional 400 ft. from the 1,900 level to the 2,300 station. Ore is being extracted from the 1,900 level, the 200-ton mill operating at capacity on a three-shift basis.

Drilling on a lower level at the Sunshine mine, Idaho, where a new mine production record was made by the Sunshine Mining Company during the third quarter.

COLORADO

Rico-Argentine Prepares For Mill Construction

Channel of Silver Creek will be changed for disposal of plant tailings—A 60-ton mill projected at the Lambertine mine, at Empire

▶ The Sweeney Construction Company, of Denver, has the contract to put in the concrete and other foundations for the new Rico-Argentine mill at Rico, Colo. A Salt Lake company will build the mill. Considerable shovel work has to be done in changing the channel of Silver Creek and the building of the tailings pond. The new flotation plant will have a capacity of 135 tons, incorporating the latest practice and machinery.

▶ The Lamartine mine, at Empire, plans to build a 60-ton mill. The mine has been rehabilitated by the Rudolph Brothers and John Jewel. George F. Calloway is in charge of operations.

▶ During the past year the Silverdale Mining Company has pursued an active program on its Argentine group, on Leavenworth Mountain, in Clear Creek County. The Kendell Brothers, from Detroit, Mich., have started rehabilitation, prospecting, and development work on the G. Lucky and Diamond mines, in the Spring Gulch section in Clear Creek County. S. A. Bennett, Jr., president of the Clear Creek Metal Mining Association, reports that arrangements have been made for the construction of a sampler in upper Clear Creek.

▶ Ernest B. Spurgeon and associates, of Salt Lake City, Utah, have leased the Clara B. and Austin lode claims from Commonwealth Tunnel Transportation Company. The new lessees will sink a 100-ft. winze on the Clara B lode from the tunnel level and will develop the Austin through the Clara B shaft. C. G. Breitenbach is president of the company and O. H. Westbrook is superintendent. Numerous small properties in this Georgetown and Idaho Springs section have been active all summer and will continue during the winter.

▶ C. B. Myers, of Dumont, Colo., has leased the Dumont mill from George Wight, of Denver, for the installation of equipment for flotation to replace stamps and amalgamation tables. Plant capacity will be 75 to 100 tons. Tentative plans have been made to dam Clear Creek at a point about 1,500 ft. above the mill, to provide hydro-electric power.

▶ John Hughes has driven around 200 ft. on one of the veins of his Independence group, in the Ophir Pass country. He is exploring the Independence vein, and will continue work, weather permitting, all winter.

▶ P. R. Long and Thomas Lilley, of Texas, who leased the Eye Opener, in San Miguel County, from D. A. McGillis, have installed a mercury table, grizzlies, and a hydraulic system above Fall Creek on the west side of San Miguel Creek, and are now equipped to handle about 60 cu.yd. of gravel per day, that averages

between 35 and 40c. gold per cubic yard.

▶ Should the 40,000-ft. drainage tunnel project for Leadville district presented to the PWA be approved, the project would provide about twenty-five hundred jobs, and when completed would permit reopening of low-grade mines not now able to operate because of water hazards.

NEW MEXICO

Copper Mines at Santa Rita Reopened

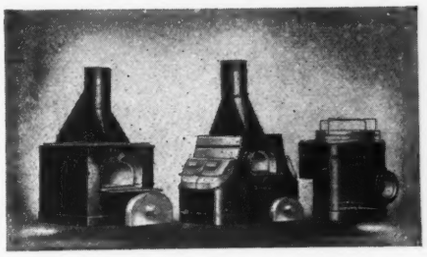
Nevada Consolidated Copper Corporation resumes operations on curtailed basis—Callahan Zinc-Lead Company obtains lease on holdings of Illinois Zinc Company

▶ The Chino unit of the Nevada Consolidated Copper Corporation at Santa Rita, Grant County, recently resumed operations, shipping concentrates to the copper smelter of the American Smelting & Refining Company at El Paso, Tex., where two furnaces were recently placed in operation, reemploying about 100 men. The new smelter of Nevada Consolidated that has been under construction during the year at Hurley, N. Mex., is expected to be blown in early next year, and active smelting operations will start on termination of the present contract with the El Paso smelter in March, 1939. Horace Moses is general manager at the Chino unit.

▶ On Oct. 4 it was announced that the Callahan Zinc-Lead Company, of Wallace, Idaho, had leased the mines and plants of the Peru Mining Company near Deming and Hanover, N. Mex., and that these properties would be operated under the name of Callahan Zinc-Lead Company until further notice. Production was resumed Oct. 15 after a shutdown of about three months. K. K. Hood is manager.

The Peru Mining Company is a subsidiary of the Illinois Zinc Company. Callahan Zinc-Lead Company has also obtained a lease on the zinc smelter and rolling mill at Peru, Ill., and a new smelter near Dumas, Moor County, Tex., having a capacity of 25,000 tons zinc concentrate per year, in two gas-fired retort blocks containing a total of 1,664 retorts. Besides interests in Utah, Colorado, Montana and New Mexico, Callahan Zinc-Lead Company early this year acquired a 51 per cent interest in the Livengood Placers, in Alaska, where gold-dredging operations are expected to start in 1940. The placer areas are situated about 60 miles north of Fairbanks, and acquisition is reported to have been based upon extensive tests made by Rogers, Mayer & Ball engineers, who drilled 594 holes covering a length of 7 miles with an average width of 1,000 ft. This was further based on the report of H. W. Parmelee, who check-drilled 66 additional holes. Goldfield Consolidated Mining Company, of Nevada, also has an interest in this enterprise. B. C. Beyer, of Livengood, Alaska, is in charge of operations.

When the Assayer "Turns on the Heat"



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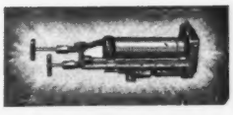

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NEWS FROM Washington

By Special Correspondent

FORECASTING continues to be a favorite Washington avocation. Since the Munich "peace" and the Congressional elections are items of the past, the favored topic now is the anticipated actions of Congress. This has double-barreled significance: What will the President propose? What will Congress do about it?

Fiscal matters will undoubtedly be in the forefront of important legislative proposals. The customary type of "balance" of the national budget can be expected in the message which will go from the White House to the Capitol during the first week of the session. Demands for continued relief spending will probably be the only major item exceeding in importance the new program of preparedness.

There is no telling how far Congress will go in war plans; but certainly there will be no parsimonious attitude in supporting Presidential requests for Naval construction, Army equipment, and general industrial preparation for any contingency. It will not be surprising even if ideas familiar under the banner of "reform" will show up again next January wearing a "preparedness" costume.

Metal Preparedness

PREPARATION by Uncle Sam for suitable defense measures includes certain mineral and metal development projects. Prominent agencies of these industries are being asked to help in bringing up to date the summary of information regarding strategic minerals. That project was carried out largely under the joint auspices of A.I.M.E. and the Mining and Metallurgical Society of America about ten years ago. The same groups are expected to cooperate in the new study. Much other official work will go on behind the scenes. But all is definitely less dominant in the thinking of official Washington than are questions of power, equipment, and industry training.

A new bottle neck seems to have been discovered with respect to power development that may apply almost equally in metal production and fabrication. This is the limitation of the capacity of equipment, machinery, and tool shops of the country. No secret is made of the official concern regarding these points. Take power as an example:

If suddenly America wanted to install a few million horsepower of additional capacity for hydro-electric and steam-electric energy, one single factor would gage the possible speed. That would be the rate at which new generators, new turbines, new boilers, and other new machinery for power plants could be designed and fabricated. Planners of Washington fear that a like limit may exist with respect to some metals and minerals.

One important illustration has been used with respect to one of the familiar strategic metals. There are new processes for production of that metal from domestic ores and there are ores of low grade which could be successfully processed if the competitive cost factor might be ignored, as it would be in time of military emergency. Mineral experts admit these facts. But nobody can tell just how long it would take to get the necessary milling and refining machinery by means of which processing plants could be built and put into successful operation.

Silver Buying

THE PRICE PAID by the Treasury for domestic newly mined silver in 1939 may be less than the current price of 64.64c. per ounce. This is the inference, but not the only meaning, which can be read into the statement of Secretary Morgenthau made on Oct. 13. He then said that no consideration had yet been given to the price for next year. Anti-silverites hope, and silver producers fear, that this was a hint of another cut to come.

Meanwhile, the Treasury continues to buy more Mexican silver recently than it bought prior to the cancellation of the formal agreement with Mexico. The continued purchases are being made "under orders," which means that either the White House or the State Department insists, for tactical reasons.

Under the present practice the purchases are made from silver producers through the New York market instead of from the Bank of Mexico. But the Mexican Government takes its toll, about 8c. an ounce, in the form of taxes. The result is subsidy to that government despite its unsatisfactory attitude toward the position taken by the State Department.

Post-Munich Peace

WASHINGTON has little better means than the average intelligent newspaper reader for determining just what the American people believe or expect regarding European affairs. The principal sources of confidential information appear no better than typical Gallup-poll results or the interpretations of columnists whose stories are daily or weekly syndicated from coast to coast.

Despite this uncertainty, Washington believes that big-Navy advocates will have pretty much their own way even without any jingoistic tactics. In fact jingoism may defeat its normal end more than help it. All this implies that large metal purchases by ship builders will be accelerated. And the merchant ship building may be pressed even more aggressively than Navy construction. This would be logical, as the Navy is far worse off for supply boats than it is with respect to fighting craft.

Other mineral interests concerned with aircraft can expect enthusiastic support for their ideas during the next session of Congress. Superior air strength of central Europe probably determined largely the Munich decision. Washington does not intend that Uncle Sam ignore this fact.

Those who backed the Neutrality Act in the last Congress will probably be in the small minority next winter. Whether that law is repealed or not, it is not expected in any way to handicap aggressive buying of supplies and equipment. The planning which by law is under the direction of the Assistant Secretary of War's office goes forward even more aggressively. Any mineral enterprise which has not indicated to that office the part which it hopes or expects to play in the preparedness program is certainly going to be out of style soon.

Taxpayers can find just one item of comfort. Government spending through preparedness channels probably means just that much less political demand for relief distribution. We may therefore have more ships, more Army barracks, better military supplies, and less in the way of leaf raking as the philosophy of the next Congress.

Labor Program

MOST COMMOTION during October on labor questions centered in the neighborhood of Administrator Andrews' office, from which new regulations were issued covering some of the fundamental Wage-Hour Act problems. That office provided business men with a definition of some important terms in the law. No less significant to business were the rulings on industries of a seasonal nature and regarding allowances for the cost of board, lodging, and other items, as furnished "free" by employers.

The general impression is that good common-sense interpretations are being applied. Mine executives in doubt on important points will tend to lean toward over-observance, though they are promised a fair deal by Mr. Andrews if they make a sincere effort to comply with the spirit of the law and happen to slip up inadvertently on a few little technicalities.

Perhaps more fundamentally important to the mining industry than any number of wage-hour regulations is the renewed effort of official Washington to find a basis on which A.F. of L. and C.I.O. may be brought back closer together. Up to late October there is no real evidence of progress in this direction, though optimistic expectations are frequently expressed by Secretary Perkins and others whose lines of communication into the labor "no-man's land" must be good.

If there were no other basis for pessimism regarding labor peace, this attitude would seem justified in the fact that A.F. of L. not only officially, but sincerely and bitterly on personal grounds, is determined to attack N.L.R.B. during the next session of Congress. The President's appeal addressed to the A.F. of L. convention was politely received and then equally politely ignored when resolution time came.

Some Washington interpreters place great stress on the fact that real cooper-

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ation is described in the official reports on both British and Swedish labor control plans. The translation of such European peace measures to the American setting will probably be very difficult, if at all feasible. These reports will, however, probably give a splendid sounding board for the more conservative members of Congress to put over their ideas that "Uncle Sam cannot do everything" with respect to labor matters.

Why Not Mines Also?

THERE IS A LITTLE CHATTER in Washington regarding mine relief. The idea is—If corn, why not silver? If cotton, why not copper? All this discussion roots in the misunderstanding of the distinction made in official minds between the price of some kinds of goods and the price of others.

The agricultural problem is undoubtedly becoming Economic Worry No. 1. The surplus of production which has not been effectively controlled by any of the agricultural measures yet devised and tried is not essentially different than the surplus problem which has burdened the major non-ferrous metals in recent years. But the low prices of cotton and corn worry officials far more than the corresponding low prices for copper ever did, just to use one example. In fact, since copper has advanced a bit during the fall, there has been some raising of eyebrows. It will not be safe, most close Washington observers feel, to sit complacently as one New York commentator did. He said, in effect, "But the President himself says that 10c. or 12c. copper is not too high." The President may not talk that way if metals go up sharply while agricultural commodities do not.

The important fundamental appears to be the distinction in Washington philosophy between farm goods and the products of mines. The distinction is not based on economic, but rather on social, considerations. Though Secretary Wallace may cleverly devise some two-price system for agriculture, there is no likelihood of that for metals. Equally futile are the proposals like that of Senator Key Pittman, that Southern cotton exports be backed by new forms of silver currency. The Western states might like that, but they are not likely to get it.

Private Truck Rules

ANY OWNER OF A TRUCK who uses it in part of his business to haul goods which are moving in interstate commerce *may* find himself as deeply enmeshed in the rules of I.C.C. as is the Pennsylvania Railroad system. This is how such a dire forecast of possibilities develops:

Under the motor vehicle act the Interstate Commerce Commission has been given definite authority as to interstate carriers using trucks whenever they work as *common* carriers or as *contract* carriers. Thus the trucking business is getting almost as fully enmeshed in ritual and report detail as are the railroads. Now comes the motor truck division of I.C.C. in an effort to apply that portion of Section 204 of the law which deals with *private* carriers—that is, the folks who own a truck and use it as a part of interstate hauling of their own goods. Under certain circumstances even this latter business is subject to regulation. And some think that mere hauling of goods to the railroad station without ever having a truck cross a state line would make the truck owner responsible.

Some of the industries are disturbed by this because of the ways in which the packing or handling of explosives and dangerous chemicals is now initially being regulated. The I.C.C. divisions interested have, so they claim, merely to make the finding that it is "necessary in the interest of safety" in regulating such business. If they so "find," they may then go ahead to control both the hours of labor of the truck operators and the condition and standards of equipment used in this business—brakes on the trucks, for example. As yet no such finding has been reached. But there are indications that such a finding is likely to be considered before long.

More significant than the hours of work and truck safety are the secondary consequences of such a finding. Suppose that this action had been taken, and the XYZ Mining Company had a few trucks then subject to Federal scrutiny. That company would not only find it necessary to limit the hours of drivers and the conditions of the vehicles; but the company would also have to make elaborate records and reports to become, as first mentioned above, as completely enmeshed in I.C.C. ritual as is a big railroad system.

One great industry has taken account of this, and is demanding formal hearings and suitable opportunity for argument before any drastic rules are formulated. It is expected that the other lines of business, including mining, may have to give attention to this matter before winter passes.

Plans for Congress

SELF - APPOINTED SPOKESMEN for the Administration have been talking during October of the Administration's five-point plan for legislation. The five points referred to are: Tax revision, railroad legislation, anti-trust law amendments, financial aid for small business, and government reorganization.

Such a list dodges at least two or three of the major subjects of prospective debate. Not the least of these will be the agricultural situation and needed further reform of A.A.A. Also of note is the proposal for revision of the National Labor Relations Act under which N.L.R.B. functions "as an ally of C.I.O." (For once A.F. of L. and the Chamber of Commerce of the United States will find themselves fighting shoulder to shoulder on this question.) The problem of "pensions" will be a third trouble-maker for Congressmen since the "$30-every-Thursday" campaign has become so popular.

It remains to be seen whether the vote getting, by out-promising one's opponent on pensions and relief, will carry through into vote casting on Capitol Hill. If it does, any guessing as to budgetary and fiscal matters is futile. Those experienced in Washington ways hope, and rather expect, that Congressmen who rode into office on promises like this may be sobered by their actual authority when legislation of importance comes up for debate and vote. But there is no expectation that all of this kind of law making can be defeated.

Even before Congress convenes, Chairman Doughton of the House Ways and Means Committee has made it clear that his group must take up pension schemes for liberalizing Federal aid to states. Perhaps most likely to pass of such legislation is some extension of Social Security assistance, or the beginning of old-age help at an earlier date than now provided by law. With an eye on 1940 elections, the proposal that pensions begin with July 1 of that year is being urged. Even without that "help," both the 1939 and the 1940 Federal deficits give prospect of exceeding three billion dollars each.

News "Fines"

Labor Espionage—It is confidently expected that the Civil Liberties Committee which has been meeting regularly under the chairmanship of Senator La-Follette will not only draft a report, but will urge definite legislation in the next Congress. Tightening up the laws on interstate travel of strike-breakers and control of arms, tear gas, and similar materials for use by industrial police are among outstanding reforms expected. The mining industry is honored by being more frequently represented than almost any other among the "horrible examples" cited by and to the committee.

Profit Sharing—Several members of the Senate have indicated that they would like to have business men suggest how industrial firms which share their profits with their employees can be given certain advantage. Some amendment of tax burdens on such employer enterprise might be considered; but the difficulty of setting a standard and defining profit sharing are hurdles not yet passed.

Trade Associations—Aside from the burden of reporting to the Monopoly Committee on all of their association activities, most secretaries of trade groups are not disturbed by the form in which the tremendous questionnaire pries into association business. There is no evidence that the "legitimate" forms of business cooperation through trade associations will be in any way harmed by this inquiry. Some executives of these groups are even hoping that a clarification of what they may not do will come about and thus aid in formulating practice for constructive purposes.

Name-Calling — The President during early October urged that business and labor get together and stop calling each other names. The parallel was quickly drawn in Washington between that situation and the controversy between business men and public officials. The pre-election breathing spell which was really observed by almost all officialdom may have represented an appreciation by the President that name-calling by those in high places doesn't do any good either. But the election is past. And so . . . .

American Mining Congress Discusses Vital Problems of the Industry

THE FIFTH annual metal-mining convention and exposition of the American Mining Congress, Western Division, at Los Angeles, Calif., Oct. 24 to 27, was attended by a record number of delegates and guests representing Western states and Eastern states. An attractive exposition of mining equipment and supplies at which manufacturers presented their latest machines for mining and milling operations interested many delegates. Papers ranged from Western mining problems to labor relations. Topics of special interest were discussed from the audience.

The first session on Monday, presided over by Charles H. Segerstrom, commenced after the formal opening by Secretary Conover, and was devoted to Western mining problems. In his paper, "The Right to Mine—Its Protection Against Encroachment," Robert M. Searls, counsel for Newmont Mining Corporation, ably explained the burdens and qualifications on the right to mine, especially with respect to taxation, S.E.C., the Wagner Act, and the Wage-Hour law. Withdrawal of the public domain from mineral entry and location and attending injustice and consequences were pointed out by Victor J. Hayek, secretary, Mining Association of the Southwest. Robert S. Palmer, secretary, Colorado Chapter, American Mining Congress, discussed the matter of coordination of State and Federal aid to mining.

Mining and the S.E.C.

The afternoon session was devoted to mine financing under S.E.C. rules. Samuel H. Dolbear, chairman, read a report of the Congress committee for cooperation with S.E.C., after which B. B. Bane, director, Registration Division S.E.C., and Howard N. Lary, regional administrator, S.E.C., Denver, explained that the Security Act is not a punitive one, but rather sets up a code of financial ethics which if followed will gradually restore the confidence of prudent investors. Mr. Bane pointed out that S.E.C. officials are always receptive to new suggestions, and will assist a registrant in every possible way. Actual experiences with S.E.C. and financial losses suffered were discussed by Paul Klopstock, chairman of board of Austin Silver Mining Company, and Harlan H. Bradt, president of Bralowe Corporation.

Developments in the industry were aired in the Tuesday morning session, presided over by J. C. Kinnear. Judge John W. Haussermann, president of Benguet Consolidated Mining Company, gave an excellent account on mining and the problems confronting the operator in the Philippines, and of what his company has done in regard to improving the standard of work and living of the native worker. The beneficiation of Coeur d'Alene silver ores was ably explained by W. Church Holmes, mill superintendent, Sunshine Mining Company, and C. T. Oughtred, concentrating superintendent, Consolidated Mining & Smelting Company of Canada, spoke on improvements in crushing and grinding practice, including his company's experience with the dry Hadsel mill. Slusher loading in driving inclines was covered in a paper by Harley A. Coy, superintendent of mines, American Zinc Company.

The afternoon session was presided over by Robert M. Searls, and topics discussed included legal, tariff, and public-relations problems. Judge Edgar T. Zook, counsel, Idaho Maryland Mines Corporation, explained the extent of mining in interstate commerce. The Trade Reciprocity Act of 1934 and matters pertaining thereto were ably discussed by Even Just, secretary, Tri-State Zinc and Lead Ore Producers Association. Congressman Scrugham, of Nevada, in his talk on the mining industry and national defense, advocated the storage of strategic metals, and pointed out that the present unrest in the world is due entirely to differences between the Haves and Have-nots, and that the United States will soon have to choose between a policy of nationalism and appeasement of Have-not nations. Ex-Governor Campbell suggested that public relations of the mining industry, and mankind generally, be brought to the public by means of well-directed exhibits, and invited operators and manufacturers to take an active part in the mining exhibition at the San Francisco Fair next year.

Health and safety were the chief topics discussed at the Wednesday morning session, presided over by William J. Coulter, Western manager of Climax Molybdenum Company. The paper by William B. Daly, general manager, Anaconda Copper Mining Company, entitled "Health Conservation of the Metal Miner," was read by Mr. Ruff, of Colorado Fuel & Iron, and the accident-prevention practice of Phelps Dodge Corporation was explained by H. C. Henrie, general superintendent, Copper Queen Branch. How the silicosis racket was started in St. Louis, and how it was broken by the St. Louis Smelting & Refining Company, was revealed by Mr. Smith, a member of the company's legal staff.

Metal Prices, Taxation, and Labor

The afternoon meeting involved discussions on metals and future prices. The paper covering copper by K. C. Brownell was read by W. J. O'Connor, manager, Utah Department, A. S. & R. Company, following which Howard I. Young, H. C. Jackson, Stanly A. Easton, Herbert A. Sawin, and Walter E. Trent respectively discussed zinc, iron ore, lead, gold, and silver. Most speakers agreed that higher prices were in the offing. Dr. John W. Finch, director, United States Bureau of Mines, spoke on what was in store for "minor metals" such as bauxite, manganese, chromite, tungsten, vanadium, and others, and what government laboratories are doing to make possible beneficiation of abundant low-grade ores. The chief address was that of Senator Key Pittman, of Nevada. Dynamically, if not convincingly, the Senator discussed and explained his recent proposal to improve the lot of the American farmer by accepting the silver of other

(*Continued on page* 80)

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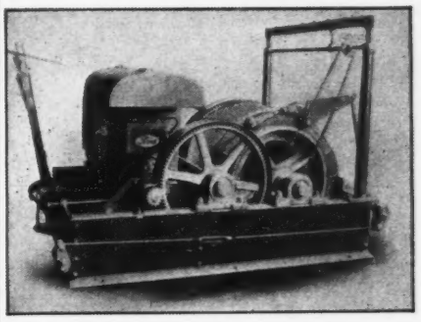

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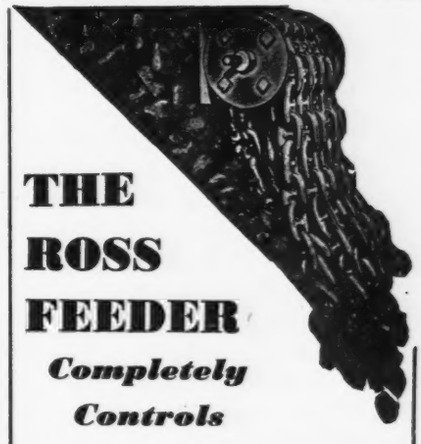

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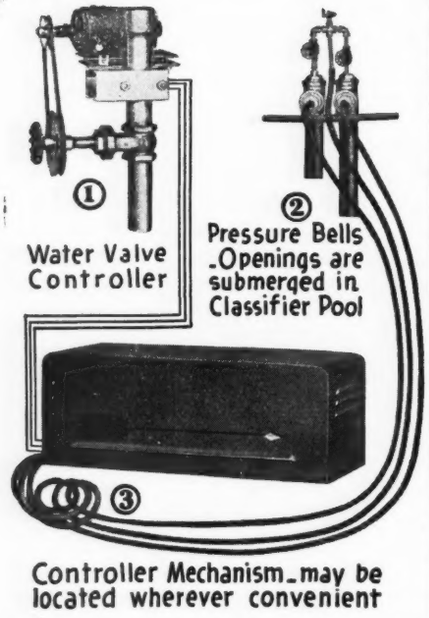

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ARIZONA

Copper Smelter at Hayden Resumes Operations

Production increased at Ray mines by Nevada Consolidated Copper Company—Employment higher at Inspiration—Several mills planned for small mines

▶ On Oct. 17 operations were resumed at the Hayden smelter of the American Smelting & Refining Company for treating larger shipments of concentrates received from the Hayden mill resulting from higher production at the Ray mines.

▶ At the Inspiration Copper Company's property about 400 men have been added to the payroll since Sept. 1, as operations get under way toward a certain production schedule.

▶ Prescott, Ariz., is soon to have a sampling plant. H. C. Smoot, 219 West Gurley St., is doing the construction work. C. T. Palladine is the engineer superintending operations.

▶ A mill is nearing completion at the Sullivan mine under lease and bond to R. A. Fredericks, Russ Building, San Francisco, Calif., associated with E. N. Beach, Congress Junction, who is directing the operations.

▶ The United Verde branch of Phelps Dodge Corporation, Jerome, is estimated to be producing around 63,000 tons of ore monthly, employing 480 men under the direction of W. M. Saben, Clarkdale, manager of the branch.

▶ A cyanide mill is being planned for erection at the Gowan mine, near Payson, Gila County, for treating dump material as well as mine ore. The property is owned by Verde Falls Gold Mining Company and is under lease to J. W. Shields, James Owen, and Martin Pomeroy.

▶ The old Christmas mine, two miles south of Roosevelt dam on the Apache trail, is regularly shipping gold ore running about an ounce per ton. A 1,400-ft. cable tramway is used to transport the ore across the upper end of the lake behind the dam. The property is owned by Mrs. W. A. Packard, of Payson, and William A. Packard, Jr., whose postoffice address is Roosevelt, is in charge.

▶ Ed. Hartwell and M. E. Rogers are unwatering the 600-ft. shaft at the Sheldon mine, near Walker, Ariz. Ore is now being taken out of the upper levels.

▶ The Carlisle mine, 16 miles east of Duncan, is shipping four carloads of ore monthly. The property is under lease to the Veta Mines, Inc. L. J. Unteriser is directing production.

▶ J. R. Mittingly and J. R. Martin, of Pearce, are unwatering the Commonwealth mine, which they hold under lease from Thomas F. Cole, of Pasadena, the owner.

▶ The Grand View Mining Company and the Chloride Reduction Company, recent Arizona corporations, have taken over the Rainbow mine and the plant of the General Ore Reduction Company. These companies are headed by Jack Martin, of Tucson, president of the Tombstone Development Company. Earl Hastings, who has been active in Mohave County mines for several years, will manage operations. Dump ores from the Rainbow will supply the mill for its initial runs while ore in the Rainbow mine is being blocked out.

▶ The Silver Bell mine, at Gleeson, is being operated under lease by A. P. Giacoma, of Tombstone. The property is owned by the Costello estate. The vein contains copper, gold and silver.

▶ Producers, Inc., have completed the installation of additional crushing facilities and the new plant has been speeded up to 220 tons daily. The new cyanide plant is working successfully. Ores supplying the mine are coming from the Pilgrim, Klondyke, and Scout properties, all controlled by the Producers company. H. W. Thorne is president of the company and manager of operations.

TRI-STATE

Eagle-Picher Company Will Operate Oronogo Mill

Stockpile of oxidized and sulphide ores to be treated—Active operations in prospect during winter months—Hartley mill leased to Sterling Lead & Zinc Company

▶ October has witnessed a continuation of the trend started in September. In view of the strengthening of the zinc market, both here and abroad, operators have been reluctant sellers, and as a result stocks of concentrates have begun to build up again. With zinc concentrates back to $33 per ton operations are increasing.

▶ The Eagle-Picher Mining & Smelting Company has taken over the operations of the 300-ton mill built jointly by the Oronogo Mutual Mining Company and the American Zinc Company at Oronogo, Mo., to treat the mixed oxidized ores from the Oronogo Circle stripping operations, according to D. C. MacKallor, of the Eagle-Picher Mining & Smelting Company. The mill was designed to treat mixed oxidized and sulphide ores from upper levels of the Oronogo Circle. Several thousand tons of ores have been stockpiled during the period of low prices. The Eagle-Picher Mining & Smelting Company will first make some changes in the flowsheet and equipment. The company reopened its zinc smelter at Henryetta, Okla., on Nov. 15, reemploying about 300 men.

▶ Sterling Lead & Zinc Company has leased the Hartley mill, in Chitwood, Mo., from the Lead & Zinc Producers, Inc., according to R. A. Hartley, of Joplin, who will be retained in charge of operations. The company also acquired the interest of Dr. E. R. Carstead, of Nevada, Mo., in a lease on an 80-acre tract of the Connor Investment Company, two miles north of Lone Elm. The lease includes mining rights on the 60-acre Taylor tract and 120 acres of the American Zinc, Lead & Smelting Company in the

Chitwood area. Operations started in early October. Principal interests in the Sterling Lead & Zinc Company are held by L. R. Hendricks and J. H. Jones, of Sterling, Ill., and Robert Dall, of Davenport, Iowa.

▶ The recently completed mill of the F & M Mining Company at Oronogo, Mo., was placed in operation early in October. It has a capacity of 15 tons per hour and will treat ores conveyed by truck from the La Tosca mine. Approximately 15 men will be employed, according to Frank Fenix, former mine inspector for southwest Missouri, who is in charge of operations. Associated with Mr. Fenix are Charles R. Martin and Dr. John M. Temples, of Joplin, Mo.

Old Pennsylvania Zinc Mine Leased

REYNOLDS METALS COMPANY, New York and Richmond, Va., is reported to have leased, with option to purchase, a 52-acre zinc-bearing tract known as the Correll farm, near Friedensville, Pa. Mining began on this property as early as 1855, and the Penn Lehigh Zinc Company made a substantial production for about 25 years. Drilling has recently been undertaken to determine the extent of the ore outside the old workings. Reported terms of the lease are $1,000 monthly rental and purchase price of $400,000. A royalty of 7½ per cent is to be paid on zinc concentrates when the selling price is less than $42 per ton, and 10 per cent when higher than that price.

▶ The new Martin tailings re-treatment mill of the Semple Mining Company, southeast of Hockerville, Okla., started operations early in October. This is one of the larger tailings re-treatment mills in the district, having a capacity of 100 tons of heads per hour. Approximately 30 men will be employed, according to Curt Martin, mill superintendent.

▶ Tri-State Zinc, Inc., placed its Ottawa and Sooner tailings re-treatment mills in operation the middle of October after a six-month shutdown. Victor C. Allen, superintendent, reports about 70 men will be employed. M. H. Loveman is manager for the company.

▶ Fire destroyed the old Howe mill, just west of Picher, Okla., on the morning of Oct. 15. This mill was built about twenty years ago and had been operated last as a tailings re-treatment plant by the W. H. Mining Company, but had been idle since late in 1937. A derrick and hopper of the J. L. Mining Company just south of the mill was also destroyed. Six men were trapped in the ground, but were able to make their way underground to the No. 8 shaft on the Netta lease of the Eagle-Picher Mining & Smelting Company, where they were brought to the surface.

MICHIGAN

Conglomerate Copper Lode Nears Exhaustion

Mine in Calumet & Hecla division has yielded rich copper ore—Recently acquired Seneca property will be developed through Ahmeek workings by Calumet & Hecla

▶ Production from the famed Calumet conglomerate lode of Calumet & Hecla is rapidly drawing to a close. Nos. 6 and 7 Hecla shafts are about exhausted and No. 12 South Hecla will be worked out in a few months. Mining of the shaft pillars and old stopes has yielded rich copper rock. The closing of the Conglomerate will leave Calumet & Hecla with one active mine, Ahmeek, and the conglomerate sands at Lake Linden and Tamarack Mills. The sands, from which copper is being recovered at low cost in two reclamation plants, will last for several years. Last year, recovery of copper from the sands totalled 20,398,000 lb., at an average cost sold of 6.63c per pound. The yield per ton of sand treated was 9.16 lb. Calumet & Hecla has only one exploratory project under way at present, the Michigan mine, in Ontonagon County. The Seneca mine, on which the company has an option, will be worked through the Ahmeek mine.

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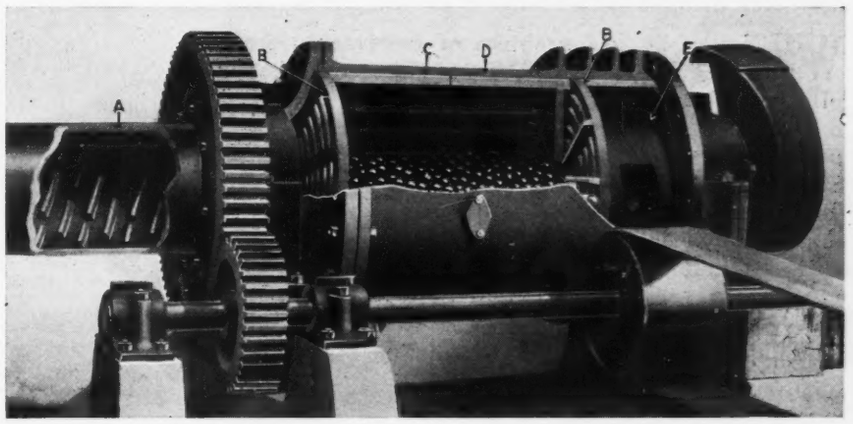

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IRON COUNTRY

Stripping Operations Planned During Winter

Ore shipments practically completed for season and outlook for next year considered favorable — Consumption of iron ore steadily rising, with higher steel rate

▶ Consumption of Lake Superior iron ore during September was 2,313,865 tons, the largest tonnage used in furnaces for some time. Supplies at the docks and furnaces on Oct. 1 amounted to 37,873,559 tons, against 39,953,601 tons at the same time last year. If the consumption of Lake Superior iron ore runs between two and one-half million to three million tons during the next six months, the balance on hand May 1 should be around 20,000,000 tons, or a normal balance. It is believed that consumption will increase from month to month, as the rate of steel production is expected to be around 60 per cent of capacity for the remainder of this year. Should this occur, a very good mining season can be expected during 1939, with production estimated between 35,000,000 and 40,000,000 tons.

▶ The Mesaba-Cliffs Mining Company is now stripping at the Hill-Trumbull mine, at Marble, Minn. The Hill-Annex mine of the Inter-State Iron Company will maintain stripping operations during the winter, and the Oliver Iron Mining Company will move overburden and rock at the Arcturus mine, at Marble, and the Morrison mine, at Coleraine. Work will also be done in the other districts on the Mesabi range by the Oliver Iron Mining Company and other independent companies.

Winter has brought mining operations in the Iron Country to a halt and operators anticipate steady demand for ore next spring, when mining resumes. The above is a small part of the Hull-Rust-Mahoning iron ore pit, where steam haulage is employed

▶ Practically all of the major companies completed their ore shipments during October, but mining companies are contemplating winter work for their employees, giving each man at least half time during the winter months.

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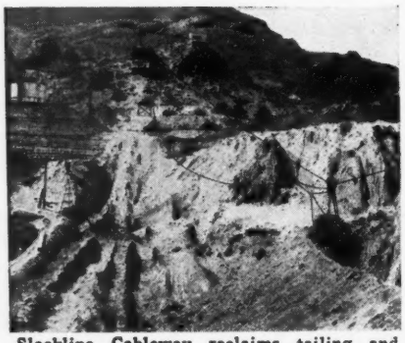

Slackline Cableway reclaims tailing and conveys to bin on hill 1,000 ft. away.

Drag Scrapers handle indoor storage of ore, coke and pitch at aluminum refinery.

ALABAMA

Tennessee Coal & Iron Reopening Mines

Greater iron-ore production at Wenonah increases employment — National Safety Award Trophy retained by men at company's Muscoda No. 5 mine

▶ On Oct. 17 operations were resumed at the Wenonah iron ore mine of the Tennessee Coal, Iron & Railway Company. This property had been idle since Jan. 2 this year. Reopening of this mine will reemploy about 200 men. On Nov. 1 work was also resumed at the Ore Mine No. 10, which had been idle since June 21. At mine No. 9 night-shift operations were added on Oct. 31. This mine on Oct. 17 was placed in production for the first time since June 21, 1938. This step-up in output will give employment to approximately 235 men.

▶ The "Sentinels of Safety" trophy, awarded by the Bureau of Mines in a national competition among non-metal mines, remains in the possession of employees of the T.C.I.'s No. 5 limestone mine at Muscoda, for another year on the basis of a perfect 1937 record. The men largely responsible for the safety performance were H. Stewart, W. Clarke, D. Baker, T. Oglesby, head miners respectively, and C. Armstrong, underground carpenter, W. Fountain, mine foreman, E. Roberson, gas inspector, E. L. Nivens, track man, E. Carter, superintendent, and E. M. Ball, general superintendent of mines and quarries.

CANADA

Electrolytic Zinc Plant May Be Erected

Province of Quebec considering merits of scheme—New sulphur plant for Aldernac Copper—Yellowknife district holds interest —Privateer mine pours first bullion

▶ Construction of an electrolytic zinc refinery in the Province of Quebec has been mentioned as a possibility by the Minister of Mines, Onesime Gagnon. It is reported that one of the leading utility companies, Shawinigan Water & Power, is interested in the project, which would be financed by American capital. Such an enterprise would be in the market for concentrates from Waite Amulet, Normetal, Noranda, and Quebec Manitou, all but the latter having shipped to refineries in England or Belgium. Premium metal now produced in Canada comes from either the Flin Flon refinery of Hudson Bay Mining & Smelting, or Consolidated Smelters at Trail.

▶ James Y. Murdock, president of Waite Amulet Mines, reports satisfactory progress with diamond drilling to the south and southeast on the spectacular new "Lower A" orebody, but no details are promised until the end of November, when the present program is expected to be completed.

▶ Recent favorable developments at the Thompson Cadillac mine are reported by R. C. Bryden, consulting engineer. On the 150 and 450 levels a definite improvement has been found in ore grade to the west in the new north zone. On the upper level two drift headings are in ore and three drill holes have opened the same zone lower down. Bob Young is mine manager.

▶ Aldermac Copper Corporation, now turning out about a million pounds of copper a month, is beginning construction of the new sulphur plant for the treatment of pyrite. In the meantime, diamond drilling from the sixth level continues to add tonnage to the new orebody that appears to represent the downward extension of the No. 4 lens.

Ontario

▶ Four parallel orebodies have been located by diamond drilling at Kerr-Addison Gold Mines, according to an interim report by the president, George B. Webster. Only one of these, 1,000 ft. east of the main workings, is not yet explored underground. A second on the 300 level has drifted 100 ft. in average-grade ore. A total width of 63 ft. is indicated by flat drill holes put out from the drift, with values of $6.60 cut grade and $12.13 uncut for the section.

▶ Highest earnings in the history of Wright-Hargreaves are shown in the annual report for the fiscal year ended Aug. 31. At 1,200 tons a day, the mill is treating more ore than ever before. Maurice W. Summerhayes, general manager, states: "Drifting on several levels between 4,000 and 5,000 ft. has resulted in satisfactory ore disclosures, especially on the 4,800 ft., developing major lengths of high-grade ore without any change of structure or formation to that of the upper levels. In addition a new vein known as No. 8, north of our present main workings, has been developed to some extent on the three deep levels commencing at the 3,500 ft., which at present indicate major possibilities." Grade of ore averaged $18.15 per ton, on which working costs were $7.35, and, after taxes and depreciation, $8.90 per ton.

Northwest Territories

▶ The massive porphyry body on the Box property of Consolidated Smelters has now opened up as the largest single body of gold ore known in Canada. The inclined shaft to a depth of 500 ft. has served as an entry for exploration which indicates a true width of 125 ft. and a length of at least 2,600 ft. There is talk of using the 1,000-ton mill, now about completed, merely as a pilot plant for determining average grade. Of the 500 men employed at this property, on the north shore of Lake Athabaska, more than half are working on hydro development. Cyanide equipment is being installed in the new mill building, and a steel headframe is being installed at the mine, where a 270-hp. diesel plant has been in use. A 22-mile transmission line leads to the electric generators, the power development including two tunnels with a total length of 2,600 ft., several open cuts, a dam and a complete power house which will begin with 3,300 hp., to be doubled later. Freight haul from Edmonton to the end of steel at Waterways and by water from there to the mine costs $26 a ton. Superintendent of the operation is P. T. Bloomer, with S. Gray in charge of all construction.

▶ Reports on a new discovery in the Yellowknife district are to the effect that L. A. Turcott, who staked the Chan Yellowknife group of claims, panned some rock with Miles Flynn. A good tailing of gold led them to clean off the rock and nuggets were seen sticking up all across the quartz, which in places was 18 ft. wide.

▶ Two diamond drills are at work on the Kim vein, southeast of Treasure Island and included in the 48 claims held by Thompson-Lundmark Gold Mines. The Kim vein is reported to be 1,268 ft. long with both ends in muskeg. Rock trenches across quartz in the footwalls have given average assays of $25 across widths of 6 in. to 2 ft. Coarse and fine gold is distributed in stringers across the full 20-ft. width of a shear zone. The spectacular discovery by Fred Thompson has been followed by finding fourteen other veins that carry visible gold and two others that give good pannings.

Labrador

▶ During the past field season the Labrador Mining & Exploration Company continued exploration on its concession of 20,000 square miles in Newfoundland territory adjacent to the Chibougamau district of Quebec. Dr. Joseph A. Retty, who has been directing work from the start of the ambitious project in 1936, concentrated efforts this summer on the large deposit of high-grade iron ore at

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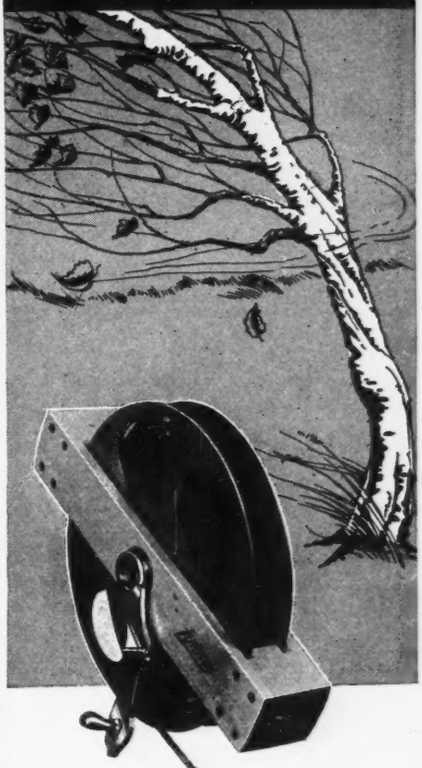

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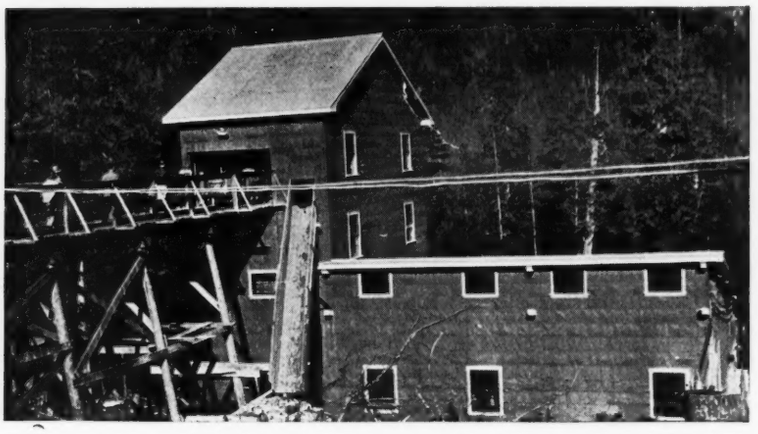

The 80-ton cyanide plant recently set in operation at the Privateer mine, Zeballos, British Columbia. Mill feed averages about 2 oz. gold per ton and recovery is 99 per cent

Sawyer Lake, 280 miles north of the Gulf of St. Lawrence. Surface work has disclosed a body of hematite 1,200 ft. in length and 200 to 250 ft. wide. Iron content averages 65.5 per cent from 120 samples, with additional samples to come. The same two Bellanca Skyrocket planes that have serviced field parties for the last two years continued to operate efficiently between the supply base at Moisie, on the Gulf, and ground crews in the interior. Weather conditions allow work to be carried on from June through September.

British Columbia

▶ The production of gold in the Zeballos area on a substantial scale was commenced on Oct. 18 with the pouring of the first bullion at the Privateer mine. Three bricks were produced, containing about 1,400 oz. of gold, valued at $50,000, but now that the mill has been tuned up, monthly output is estimated at $100,000 or $125,000. At present 80 tons of ore is being treated per day and 150 oz. recovered in jig concentrate and amalgam, indicating millhead of nearly 2 oz. gold per ton. The property is unique not only for the richness of the deposit but also for the speed with which it has been developed. In nineteen months it has progressed from the prospect to the producing stage, with about three years' supply of ore already proven. The ore in place averages between 3 and 4 oz. per ton, and gross value of reserves is about $5,000,000. The width of the vein as opened at five levels averages 12 in., and the stoping width is between 30 and 36 in. G. F. MacDonnell is consulting engineer, J. W. Murray is manager, and N. E. McConnell is mine engineer.

▶ A second property in the Zeballos region will commence production in November. A 50-ton flotation amalgamation mill is being installed at the Goldfield property of Spud Valley Gold Mines, Ltd., 2½ miles up the road from the Privateer. William Elliott is superintendent.

▶ A small Chilean type mill is in operation at the Rey Oro mine, Zeballos, treating about 5 tons of sorted high-grade ore and yielding about $700 per day. Edward G. Brown is managing director.

▶ Premier Gold Mining Company has taken a 50-year bond on the property of Abco Mines, Ltd., on Herbert Arm, west coast of Vancouver Island. Work is to be started at once.

▶ Bralorne Mines, British Columbia's leading gold producer, situated in the Bridge River valley, will erect a new sorting plant and install another 2,050-cu.ft. compressor unit.

▶ Milling capacity at the Dividend mine of Osoyoos Mines, Ltd., Osoyoos, B. C., is to be increased from 90 to 150 tons, in view of satisfactory results obtained in development during the past year. J. O. Howells is manager.

▶ Production of copper is being maintained at capacity by British Columbia's major producers, notwithstanding the prevailing low price of the metal. Britannia's output will probably be somewhat in excess of the 33,000,000 lb. produced in 1937, and the rate of output from the Copper Mountain mine of the Granby Consolidated has been increased by 20 per cent recently to 2,500,000 lb. a month, or 30,000,000 lb. a year. Britannia's concentrate is marketed in the United States and that of Granby in Japan.

▶ The new underground mill at the Big Missouri, Stewart, B. C., treated 20,805 tons in August for a gross recovery of $67,000 and a net profit of about $25,000. At the Silbak Premier mine, in the same district, 16,635 tons was milled in August, averaging 0.23 oz. gold and 4.91 oz. silver per ton. Net smelter returns were $134,903 and the gross profit was $49,612.

▶ Excellent results are being obtained at the most northerly producing mine in the Province—the Polaris-Taku, near Tulsequah, in the Atlin district. The mill is treating about 6,000 tons of ore a month, averaging ½ oz. gold per ton. D. C. Sharps, of Vancouver is consulting engineer, and B. B. Nieding is superintendent.

MEXICO

Miners Cooperative Takes Over Tigre Mine

Old silver property in Sonora will be worked by employees—Strike at Cananea and San Francisco Mines settled—Men ordered to return to work at Monterrey lead refinery

▶ Though labor and other unrest continues in the Mexican mining industry, mid-fall found some little improvement in conditions. Two strikes that had far-reaching and disadvantageous consequences were settled—that of Cananea Consolidated and that of the American-owned coal mines in the Nueva Rosita sector, Coahuila.

▶ The 200 employees of El Tigre Mining Company, in Sonora, were recently granted a petition by the Federal Government to work the property as a cooperative.

▶ Cananea Consolidated, Cananea, Sonora, settled the strike of 1,200 mine and plant employees by agreeing to the following: A general daily salary raise of 1.25 pesos (25c.), plus 5 centavos (1c.); annual vacations, with pay of from nine to twenty days; cash bonuses at the rate of 25 days' pay per year of employment for voluntary retirements; free life insurance of 750 pesos ($150) per employee; compensations of 1,050 pesos ($210) for total and permanent incapacity and 810 pesos ($162) for death; 30,000 pesos ($6,000) to found a free clinic for employees' families; 3,000 pesos ($600) a year for free medicines and doctors; abolishing company stores; aiding the workers' consumption cooperative society; payment of salaries during the strike, and footing costs of the strike.

▶ The Fresnillo Company, Fresnillo, Zacatecas, settled work troubles that threatened a strike by allowing employees most of their demands.

▶ San Francisco Mines of Mexico recently allowed most of the workers' demands in a new contract, thereby avoiding serious labor trouble.

▶ Strikers at the Monterrey lead refinery of the A. S. & R. Company were ordered back to work by government officials pending negotiations of labor demands.

▶ Mining cooperative societies obtained exemption from the 12 per cent export tax on their silver shipments and a 50 per cent reduction in the levy on their gold sales abroad, but, at this writing, there is no indication that this privilege will be extended to the industry as a whole.

▶ The company being organized to exploit a rich gold deposit recently discovered in the Maguarichic region, Chihuahua, has been named Cia. Minera de la Bufa. George M. Rich, a Chicago mining man, has been chosen president. Jose Maria Garza Aldape, Chihuahua City, is in charge of operations.

▶ Moctezuma Mining, Nacozari, Sonora, H. H. Horton, general manager, is con-

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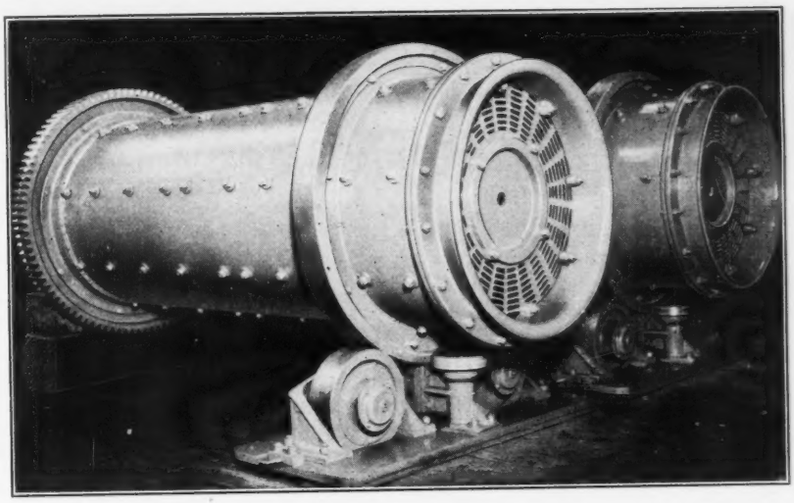

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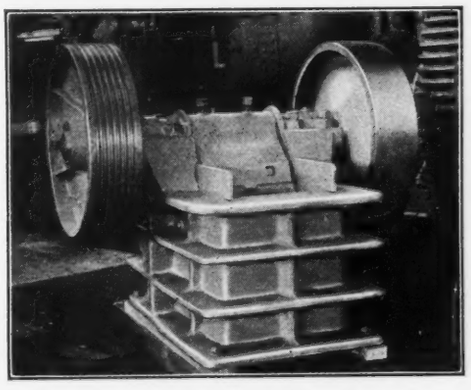

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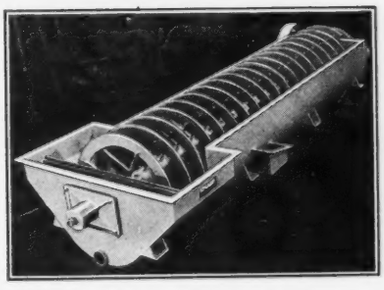

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▶MEXICO

ditioning its copper mines for early resumption of work which will employ a large number of men.

▶ President Lazaro Cardenas has ordered included in the federal mining reserves all free lands containing deposits of tungsten, aluminum, antimony, molybdenum, nickel, magnesium, manganese, and chromium; also flourite.

▶ Granting the workers' demands for higher wages and other benefits would swell the company's annual overhead by 32,000,000 pesos ($6,400,000), representatives of Real del Monte y Pachuca, Pachuca, Hidalgo, told the Federal Labor Department that called conferences in an endeavor to settle labor trouble at these mines. Demands include a general wage raise, paid yearly vacations and free medical service and medicines. The miners told the department that granting their demands would only cost the company 14,000,000 pesos ($2,800,000) a year extra. They spurned the firm's offer to allow benefits which would tack 1,500,000 pesos onto annual overhead, contending that this means only a 3 per cent pay raise, which the miners consider too little for 7,000 workers.

▶ Labor troubles are harassing Cia. Minera Azteca, S. A., Cumpas, Sonora, and may result in reduction of work.

▶ Expropriation as a public utility of the Doce Apostles property, Guerrero, is being agitated by the employees, who want to run these mines on a cooperative basis with Federal Government assistance.

▶ A 50-ton Gibson mill is to be installed this fall by Sinaloa Mining on its properties at Cosala, Sinaloa. F. F. Gerad, Bellingham, Washington, mining man, heads this company.

TURKEY

Copper Concentrator and Smelter to Be Built

Murgul Maden mine, in Province of Artvin, plans extensive development and exploitation program

▶ Part of an $80,000,000 loan to Turkey by the British Government will provide capital for the development and production of copper from the Murgul Maden mine, formly the property of the Caucasus Copper Company, operated by English and American capital until 1916. The British Geco Engineering Company, of London, England, affiliated with the General Engineering Company, of Salt Lake City, Utah, has entered into an agreement with the Eti Bank of Ankara, Turkey, for the design and construction of a 2,000-ton concentrator, a 200-ton smelter, and a hydro-electric power plant to be installed at the copper mine, which is near Borcka, in the Province of Artvin, Turkey. The work will be under the direct charge of J. M. and M. J. Callow. Production is expected to start about the middle of 1940.

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GERMANY

Copper and Lead Deposits Receive More Attention

Low-grade ores will be exploited, with production expected in 1940 or later—Sudeten area, recently gained, contains no base-metal mines

▶ Interest in what Germany may obtain from mineral deposits in the recently acquired Sudeten area must be confined to non-metallics, as base-metal deposits are virtually non-existent. Certain facts obtained from the Bureau of Mines make it possible to base an opinion on such matters as coal and lignite produced in Sudeten Bohemia and North Bohemia respectively. Radium mines in Joachimsthal were of past importance but are handicapped today by low world market price. Production nets about a few grams annually. Radium salts and uranium oxides, however, are produced and marketed in small quantities. China clay is produced at Most and Karlstad, and graphite mines near Moravian Alstadt ship output to the Hardmuth Pencil Company in South Bohemia.

Germany, besides pushing construction of steel plants, which will not add to her requirements until 1940 or later, is developing copper mines at Reichelsdorf, near Eisenach, and at Goldberg, in Silesia. These low-grade deposits are estimated

to contain a million tons of copper, and mills, smelters, and thousands of workmen's houses are under construction; but production probably will not be under way until 1940 or later. At Mecherniche, near Aachen, extensive low-grade lead ore deposits have been developed and a plant to treat 3,000 tons of ore per day will be built, together with a smelter, the output of which is estimated to be 60 tons of lead per day. Completion of this project is expected in 1940.

AFRICA

Encouraging Results Continue on West Rand

Drilling reveals good ore below 3,500 ft.—Roan Antelope will complete western extension program

▶ For a time the threat of war caused fear that the development and equipment of new mining properties and the expansion of productive capacities in South Africa would have to be deferred. But confidence and courage have returned, and it is considered quite certain that at least one new Witwatersrand company will be floated in the near future.

▶ West Witwatersrand Areas has made a further important disclosure, E.2B borehole having cut the Ventersdorp Contact reef at a depth of 3,512 ft. where it showed 34.1 dwt. over a true width of 19 in. This borehole is midway between two others which revealed good values in the Main reef. The Main reef area covering these other boreholes has hitherto been considered for financing and whether it will be extended to include the Ventersdorp Contact recently disclosed is not known. These boreholes, all in the vicinity of Farm Driefontein, have revealed conditions which warrant shaft sinking.

▶ No further discovery has yet been reported by Western Holdings, but one is expected almost daily, as its drills are approaching an interesting zone.

▶ A mechanical breakdown at shaft No. 2 reduced the output of Spring Mines about 36,000 tons during October. The monthly output of ore is about 150,000 tons.

▶ The remarkably rich developments by Ashanti Goldfields in its deepest levels are expected to give fillip to the gold-mining activities in the Gold Coast Colony. Several of the newer mines there are doing well, notably Bibiani, Marbu, Gold Coast Banket, Ariston, and Amalgamated Banket Areas, and other companies are exploring promising properties. Deep drilling at several points is now suggested.

▶ Roan Antelope's report for the year to June 30 shows net earnings of £1,775,068 after the transfer of £200,000 to the replacements and obsolescence account (against £175,000), which, in view of the lower price for copper, was much nearer the £2,041,830 earned the preceding year than expected. Production was 75,253 long tons of blister copper at a total cost of £24.809 per ton, including everything except taxation, against 69,560 tons the preceding year at a cost of £25.496 per ton. The average price

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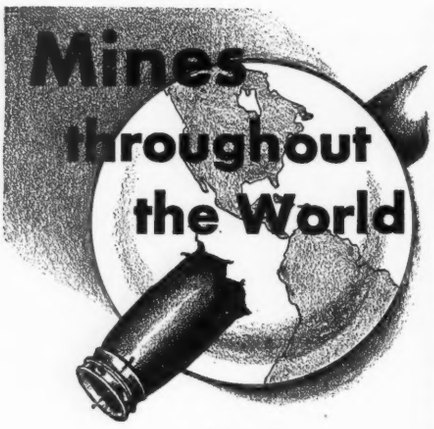

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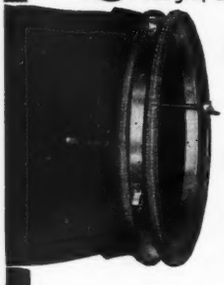

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▶AFRICA

received for its copper was £45.469 per ton, against £51,022. Capital expenditure during the year was £200,659, and there was a further expenditure of £587,574 out of the replacements and obsolescence reserve, the sinking and equipment of the Storke and No. 15 shafts being charged to this account. It is estimated that a further £750,000 will be expended during the current year to complete the western extension program and various plant enlargements which will bring output capacity up to 10,000 short tons of copper per month. The western extension work has been carried forward with great energy, ventilating shafts being sunk and hoisting shafts being in process of equipment. Underground development has been carried far beyond the Storke shaft—how far is indicated by a statement by Frank Ayer, general manager, that ore from development on the south limb was transported a maximum of 3.05 miles to the Beatty shaft. These extensions have penetrated ore not yet included in the reported ore reserves which stand as 87,498,099 short tons averaging 3.43 per cent copper. Roan is strong financially, having net quick assets of £1,094,700.

American Mining Congress

(*Continued from page 71*)

nations at a statutory price of $1.29, which, for instance, will permit them to purchase 10 lb. of American cotton for 1 oz. of silver.

Taxation and labor were also discussed. After a short talk by chairman Henry B. Fernald, Granville S. Borden, tax counsel, San Francisco, explained the Revenue Act of 1938 with special reference to mining problems. A simpler tax structure and limitation of expenditure within the maximum tax yield were suggestions recommended by Ellsworth C. Alvord. In his paper, "The Public's Interest in Mine Taxation," A. G. McKenzie, secretary, Utah Chapter, American Mining Congress, pointed out the necessity of bringing mine tax problems direct to the public. The chief address during the afternoon session, presided over by D. D. Moffat, was that of Senator Edward R. Burke, of Nebraska, who spoke on labor relations at home and abroad. Senator Burke advocated amendment of the present N.L.R.B. Act to restore industrial peace in the United States. He declared "the purpose of the N.L.R.B. Act was to diminish the causes of labor disputes. Because it has so signally failed in operation to carry out that declaration of purpose, because labor disputes appear to thrive and multiply under its influence, the time will soon be at hand to consider substantial changes in our policy." Preceding the reading of the report of the resolutions committee, Wesley O. Ash, Wage-Hour Division, United States Department of Labor, told the audience what the new Wage-Hour Act meant and how it was to be administered. Harvey S. Mudd was toastmaster at the annual dinner at the Ambassador Hotel, at which Cornelius F. Kelley, president, Anaconda Copper Mining Company, delivered the principal address.

AUSTRALIA

Gold Dredge Installed in New South Wales

Good yields made from units now in operation — Ore depletion closes one of Broken Hill Proprietary's mines. Central plant to treat Cloncurry copper ores

▶ For the first half of 1938, official figures show that Australia's gold yield was 746,318 oz. As the figure for the second half should be somewhat greater it appears that the year's yield should approach 1,600,000 oz., or over 200,000 oz. more than that of 1937.

New South Wales

▶ The Broken Hill Proprietary Company is to install a dredge on its Burrendong property, close to the property of Wellington Alluvials, Ltd., which was formed by the Company in 1936.

▶ Granites Development, N.L., which is operating a 6-cu.ft. dredge, fitted with Harz jigs, at Glen Elgin, has had improved returns lately, and is now averaging 50 oz. gold and 30 ewt. tin concentrate weekly from the treatment of 12,000 cu.yd. of wash. The property contains a total of about 2,750,000 cu.yd. of wash, but prospecting work now in progress may increase this amount.

▶ The closing down, in November, of the Broken Hill Proprietary Company's mine at Broken Hill is announced by the company, the reason being the depletion of ore reserves. This, for many years the premier mine of the field, has produced in the 53 years of its life over

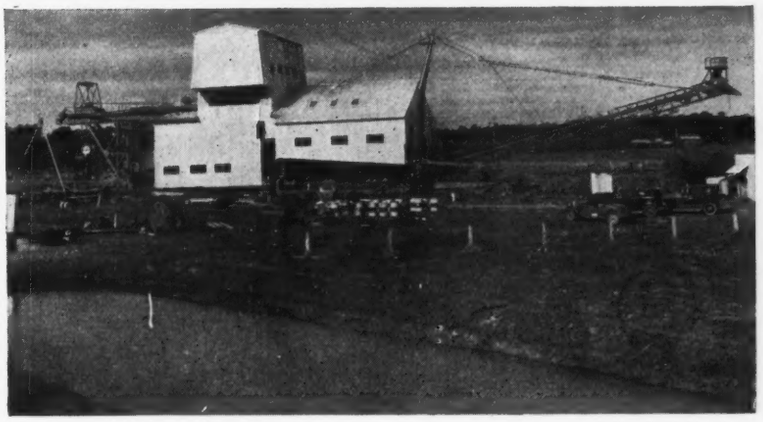
Copper Cartel Lifts Production Restrictions

▶ After announcing in London on Oct. 10 that production of copper by the group participating in the foreign control plan would be raised 10 per cent, to 105 per cent of the basic tonnages, effective Oct. 15, action was taken by the Cartel on Oct. 17 to remove all output restrictions, retroactive to Oct. 15. The quick move to raise production was taken to check unreasonable price movements. Fear of governmental intervention in a runaway copper market was held to be a factor by some operators in opposing the advance in the price of the metal, as Great Britain is expected to absorb large quantities of copper for armament purposes.

Changes announced in production quotas by the foreign group since August, 1936, were as follows:

	Operating Rate, %
Aug. 1, 1936	75
Oct. 1, 1936	80
Oct. 15, 1936	85
Nov. 1, 1936	95
Nov. 6, 1936	105
Jan. 14, 1937	Unlimited
Dec. 1, 1937	105
July 1, 1938	95
Oct. 10, 1938 (a)	105
Oct. 17, 1938 (b)	Unlimited

(a) Effective Oct. 15, 1938. (b) Retroactive to Oct. 15, 1938.



A 9½-cu.ft., resoiling gold dredge at Newstead, Australia. Oversize is delivered 15 ft. behind, and sand is dumped at 25 ft. Dry overburden is conveyed to a point 104 ft. behind and then scrapers level off the new ground

12,000,000 tons of ore, yielding 1,445,000 tons of lead, 189,000,000 oz. of silver, and 603,000 tons of zinc.

▶ The new mills of The Zinc Corporation, Ltd., and North Broken Hill, Ltd., are nearing completion and should be in operation early next year. The former, which is to employ the all-flotation process, has a rated capacity of about 440,000 tons yearly. The North mill, which will use the more conventional Broken Hill practice of jigs, tables, and flotation, is of 600,000 tons' yearly capacity. With the completion of these plants, the milling equipment of the three large mines (North, South, and Zinc Corporation) will be thoroughly up to date, and an increase in the already high treatment efficiency of the field may be looked for.

▶ Broken Hill Proprietary Company recently exercised its option to purchase the Cowra Creek mine, near Cooma, which carries good values of gold in pyrrhotite with occasional arsenopyrite and chalcopyrite. The mine has been developed to a depth of 150 ft.

Western Australia

▶ Two new discoveries of gold have recently been made, one at Mitchell's Patch and one in a hitherto unprospected area 90 miles southeast of Laverton. In both instances rich surface showings are reported, and prospectors are busy in both areas.

▶ Recent developments have indicated improving prospects at Wiluna. Two new shoots of ore have been proved at the 1,000 ft. level in the east lode north of the main shaft. Average value exceeds 4 dwt. per short ton, and combined length is 778 ft. over widths of 10 to 15 ft.

▶ Norseman Developments, N.L., a subsidiary of Norseman Gold Mines, N.L., is reopening the old Westralia Waihi mine, at Norseman, where it holds leases covering a strike length of a mile on the Northern Star reef.

Queensland

▶ A proposal to install a central treatment plant to handle the copper ores of the Cloncurry field is under consideration by the State Government, which has engaged A. F. McAskill, late general manager of Mount Morgan, Ltd., to investigate and report on the feasibility of the project. At present ore from the field is railed a long distance to the Chillagoe State Smelters, forming the bulk of the material treated at that centre.

Victoria

▶ Victoria Gold Dredging Company, N.L., operating a 9½-cu.ft. resoiling dredge at Newstead, has declared its initial dividend of 2s. per share just two months after commencing operations. Excellent returns have continued, the yield averaging to date about 8 grains per cubic yard, including the opening-out period. About 28,000 cu.yd. weekly is being treated. The dredge is operated at somewhat below rated capacity in order to insure careful cleaning of the bedrock, on which rich values of coarse gold are being found.

Tasmania

▶ Output from the tin-sluicing property of Briseis Consolidated, N.L., at Derby, is increasing, latest month's return being 45 tons tin oxide from 75,000 cu.yd. treated, an average of 1.34 lb. per cubic yard. Costs are 14.6d. per cubic yard.

▶ Ore reserves of Renison Associated Tin Mines, N.L., Renison Bell, West Coast, are estimated at 615,000 tons assaying 0.85 per cent metallic tin. The ore, which is highly pyritic, will be crushed and floated for the production of a pyritic concentrate, the tin oxide being recovered from the flotation tailings by gravity methods.

▶ Magnet Silver-Lead Mines, N.L., at Magnet, is now treating 240 tons of ore weekly, and expects to double this output soon.

New Guinea

▶ Bulolo Gold Dredging had a large increase in output for August, 16,209 oz. fine being produced from 1,249,000 cu.yd. of gravel. The working profit of £100,695 (Australia) was the highest monthly figure in the history of the company.

Only 85 lbs., but MAN... WHAT A PUMP!

The BYRON JACKSON SINGLE-STAGE PNEUMATIC SPONGE CAN'T BE BEAT FOR "Mopping-Up" Service

This little pump can be carried on a man's back, since it weighs only 85 lbs., but when it's set down and connected, it does a giant's work — 300 gallons per minute against a 25-foot head, or 120 gallons per minute against a 57-foot head, or 75 gallons per minute against a 125-foot head *with only a 90-pound air pressure.*

This Byron Jackson Single-Stage Pneumatic Sponge is easily set up or dismantled and will operate in any position. It is sturdily constructed with a two-port, nonclogging hardened impeller that passes ⅝ inch solids and lowers the water to within 3 inches of the bottom. This design provides maximum resistance to abrasives, such as sand, pulverized rock, etc.

Byron Jackson Co., Dept. MI-28
P. O. Box 1307 Arcade Station
Los Angeles, California

Please send me complete information about the Byron Jackson Single-Stage Pneumatic Sponge.

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Company.....

Position.....

City.....State.....

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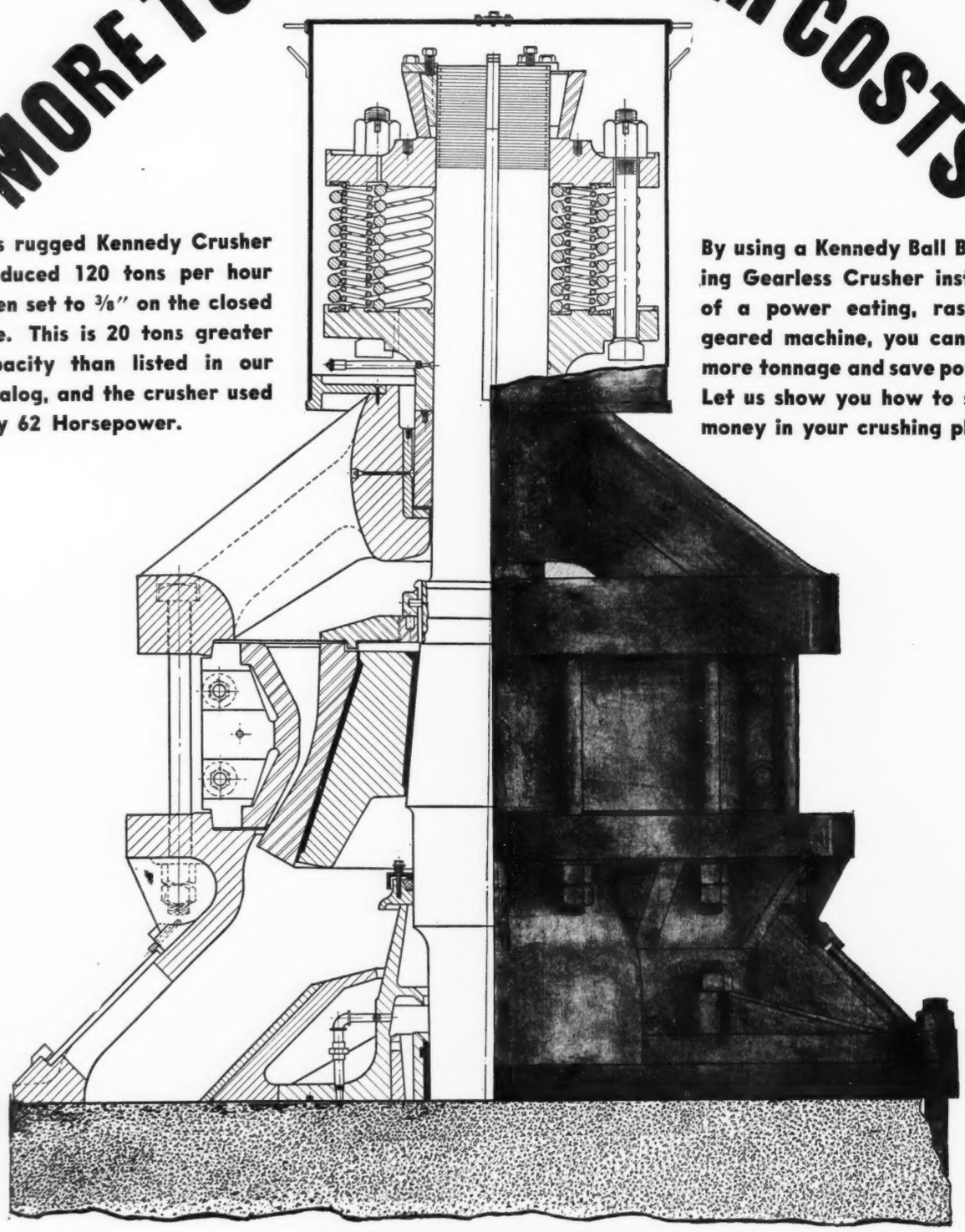
BYRON JACKSON CENTRIFUGAL PUMPS Estab 1872 **FOR EVERY SERVICE**

MORE TONNAGE-LOWER COSTS

This rugged Kennedy Crusher produced 120 tons per hour when set to 3/8" on the closed side. This is 20 tons greater capacity than listed in our catalog, and the crusher used only 62 Horsepower.

By using a Kennedy Ball Bearing Gearless Crusher instead of a power eating, rasping geared machine, you can get more tonnage and save power. Let us show you how to save money in your crushing plant.



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NEW BOOKS

ALLUVIAL PROSPECTING AND MINING. *By S. V. Griffith. Mining Publications, Ltd., 724 Salisbury House, London, E.C.2, England. Price 12s. 6d.*

THE TITLE of this book of 139 pages promises rather more than its contents reveal. Certainly any book entitled "Alluvial Mining" should not leave out dredging as this one does. A better title would be "Placer Miner's Handbook of African Practice."

The first chapter plunges into the subject of prospecting methods and appliances used in placer mining without so much as a definition of alluvial mining, to say nothing of any explanation of how and where placers are formed, or what minerals may be found in them.

Throughout the book one is conscious of the fact that the methods are based on having plenty of "native boys" at hand for the work.

The author states in his preface that he hopes that young engineers will find the book useful, and to a limited extent it may serve this purpose. It would not, however, tell the young engineer how to determine the unit value of his gravel, for it makes no mention of the varying fineness of placer gold or whether the test-hole concentrates are assayed, amalgamated, weighed, or what. Nor does the book state what equipment is needed for the purpose. No mention whatever is made of alluvial tin. In the chapter on alluvial diamond mining the only comment on the concentrates—that is, the diamonds which are the *sine qua non* of the whole operation—is that they "are sent to the pickers for picking."

The entire treatment of the subject is purely technical and the economics of the process are meticulously avoided. Neither losses nor recoveries are discussed nor do labor and climatic conditions receive adequate treatment. Wage scales are not even mentioned.

The tables, formulas, and illustrations are good and the emphasis placed on the necessity for keeping accurate records of work performed is commendable. An American is conscious of the English terms, which do not accord with American usage. A good part of Joshua Hendy's Bulletin 128 is reproduced in the chapter on hydraulic mining. This is good material which was copyrighted in 1922 and is now out of print. Chapter VI skims over drift mining and then treats of draglines, power shovels, scrapers, and cableways as a means of moving overburden and gravel.

A seven-page chapter on alluvial diamond mining on the West Coast of Africa closes the book. The diamondiferous gravel is treated by washing, sizing, and jigging. A flowsheet of the process is given and the operation is described.

As a handbook for rather primitive and small-scale placer mining it will do, but not as a book on alluvial prospecting and mining. If a young engineer depended upon this book for his knowledge of alluvial mining he would not even suspect the high plane of the art or the tremendous size of the operations as carried out some 50 years ago at the height of river mining and hydraulicking, or the present state of the art of dredging by both small and large dredges.

C. N. SCHUETTE

METALLURGY. *By Carl G. Johnson, R. S. Dean, and J. L. Gregg. American Technical Society, Chicago, Pp. 149. Price $1.50.*

WHETHER one calls this a sketch or a synopsis of the fundamentals of physical metallurgy or an introduction to the science of metallurgy, as does the senior author, it is all the same. It is, in fact, a presentation of the aforesaid fundamentals in language simple enough to be called popular, yet entirely sound, with adequate though not profuse illustrations. It is easy reading. Many who wish to know the principal facts of physical metallurgy without delving into the details will find it useful.

PUBLICATIONS

RECEIVED

Copper Mining in North America. By E. D. Gardner, C. H. Johnson, and B. S. Butler. Bulletin 405, U. S. Bureau of Mines, Washington, D. C. Pp. 30.

Flotation for Recovery of Scheelite From Slimed Material. By E. E. Leaver and M. B. Royer. Pp. 585. U. S. Bureau of Mines. Sold by Superintendent of Documents, Washington, D. C. Pp. 24. Price 10c.

Air Hygiene Foundation of American Bulletins. Preventive Engineering Series No. 2, Part 6, "Determination of Lead in the Air"; No. 2, Part 7, "Identification of Industrial Dusts." These bulletins give specific directions for chemical and microscopic procedures.

Barite in Tennessee Valley Region. By W. J. Penhallegon. Geological Bulletin No. 9, Tennessee Valley Authority, Knoxville, Tenn. Pp. 37. Also Bulletin No. 10, on "Iron Chromite and Nickel Resources of the Tennessee Valley Region," by E. C. Eckel, C. E. Hunter, and P. W. Mattocks.

Electrometallurgical Investigations. Metallurgical Division, U. S. Bureau of Mines. R. I. 3406. Three progress reports: "Electrolytic Manganese," by S. M. Shelton, M. B. Royer, and A. P. Towne; "Boulder City, Nev., Electrometallurgical Laboratory," by J. Koster and R. G. Knickerbocker; and "Pullman, Wash., Unit, Electrometallurgical Section," by H. A. Doerner. Pp. 28.

About Petroleum. By J. G. Crowther. Oxford University Press, London, New York and Toronto. Pp. 181. Price $2.25.

Lefax Traverse Tables. A complete set of five-place tables showing the differences of latitude and the departures for every minute of the quadrant. Lefax, Incorporated, Ninth and Sansom Sts., Philadelphia, Pa. Pp. 92; 6¾x3¾ in. Price, paper cover, $1.50.

Simplified Methods for Computing Stresses in Rigid Frame Buildings. By Sheldon A. Keast. Published as a Lefax data book. Lefax, Inc., Philadelphia, Pa. Pp. 40. Price $1.

Steel Construction. Revised edition. By H. J. Burt and C. H. Sandberg. American Technical Society. Pp. 438. Price $3.50.

Mining, Milling, Refining, Investment. An introduction to the mineral industry. By Charles Spearman. Published by Canadian Record of National Development, Montreal, Canada. A popular treatise "to serve as a link between the laity and the mineral industry."

Geology and Ore Deposits of the Southwestern Arkansas Quicksilver District. By J. C. Reed and F. G. Wells. Bulletin 886-C. U. S. Geological Survey. Pp. 90, with maps. Sold by Superintendent of Documents, Wash., D. C. Price 75c.

Geology and Ore Deposits of the Mammoth Mining Camp Area, Pinal County, Arizona. By N. P. Peterson, University of Arizona bulletin. Pp. 63, with map supplement.

Geology of the Bay St. George Carboniferous Area. By A. O. Hayes and H. Johnson. Bulletin 12. Geological Survey of Newfoundland, St. John's. Pp. 62.

Gold Placers of the Fortymile, Eagle and Circle Districts, Alaska. By J. B. Mertie, Jr. U. S. Geological Survey, Bulletin 897-C. Sold by Superintendent of Documents, Washington, D. C. Pp. 133-261. Price 20c.

Geology and Ore Deposits of the Lordsburg Mining District, New Mexico. By S. G. Lasky. U. S. Geological Survey Bulletin 885. Sold by Superintendent of Documents, Washington, D. C. Pp. 62. Price $1.25.

Copper Ores of the LaPlata District, Colorado, and Their Platinum Content. Edwin B. Eckel, Vol. 13, No. 12, of the *Proceedings* of the Colorado Scientific Society. Denver, Colo.

Annual Report, 1937. Colorado Bureau of Mines. Includes a list of operating mines. Pp. 85. State Capitol, Denver, Colo.

Finland Geological Commission. Bulletin 121, "Die postglaziale entwicklung des Südwestlichen Finnlands," by E. Aurola. Pp. 166. Bulletin 122, "On the Petrology of Finnish Quartzites," by A. Hietanen. Pp. 124. Bulletin 123, Miscellaneous Papers of the Geological Society of Finland. Pp. 107.

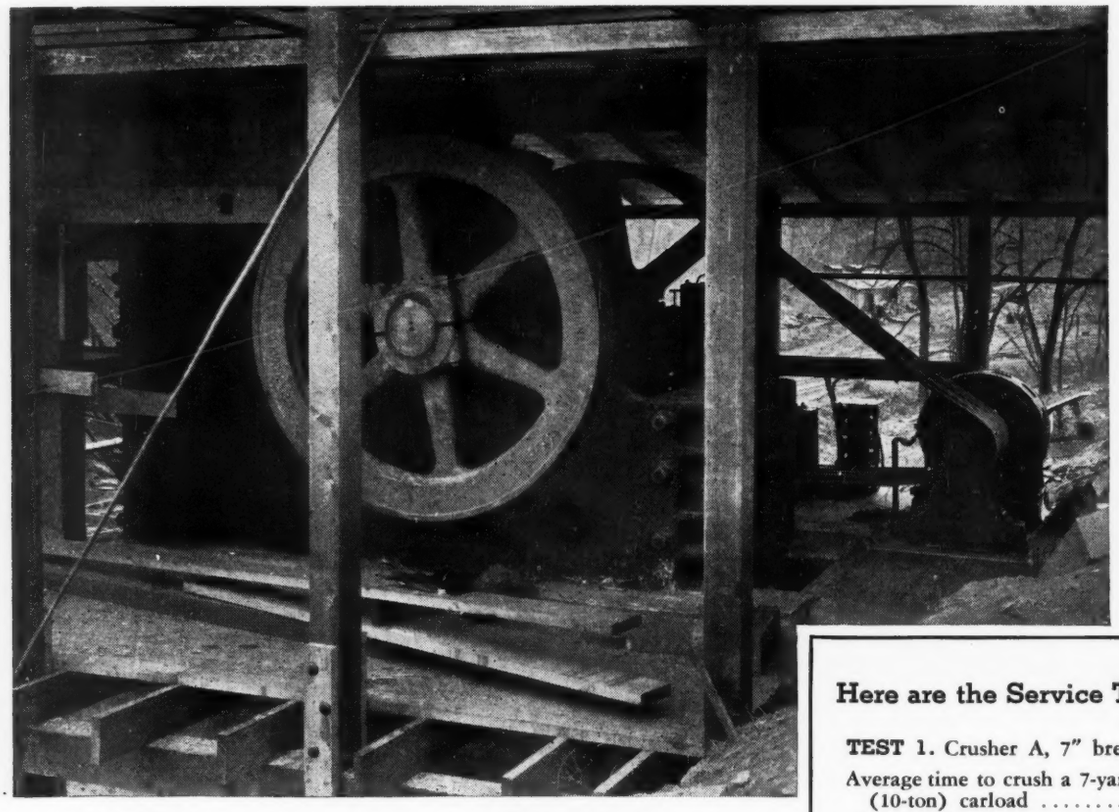
Granites of the Serra de Cantareira, Brazil. By Eng. Luiz Flores de Moraes Rego and Eng Tharcisio D. de Souza Santos. Bulletin 18, Instituto de Pesquisas Technologicas de S. Paulo. In Portuguese. Pp. 162, with separate map supplement.

Report of the Director, 1937. National Department of Mineral Production, Rio de Janeiro, Brazil, pp. 194 plus charts. In Portuguese. The Department has also issued a number of other bulletins in Portuguese, including: "Economic Geology of Northern Minas Geraes," by Luciano Jacques de Moraes and others (pp. 192); "Graphite in Minas Geraes," by Othon Henry Leonardos (pp. 24); and "Bauxite in Pocos de Caldas, Minas Geraes" (pp. 71).

Gold in British Guiana. Bulletin No. 7, reporting on a geological reconnaissance survey of part of the Northwest District, by S. Bracewell (pp. 37, price 24c. local currency); and Bulletin No. 9, reporting on an area between Quartzstone Head, Aremu mine, and the Puruni River, near Peters mine (pp. 20 and maps, price 12c. local currency). Issued by Geological Survey, Georgetown, Demerara.

Canada. Report on Mineral Production During Six Months Ended June, 1938. Pp. 32. Price 25c. Also Summary Review of Gold Mining Industry, 1937. Pp. 67. Price 25c. Also Annual Report on Mineral Production of Canada, 1936. Pp. 309. Price 50c.

Canada. Geological Survey. "Cranbrook Map-Area, British Columbia." By H. M. A. Rice, Memoir 207, pp. 67 and maps, price 25c. Also "Thetford, Disraeli, and Eastern Half of Warwick Map-Areas, Quebec," by H. C. Cooke, Memoir 211, pp. 160, price 50c. Also "Mining Industry of Yukon, 1937," by H. S. Bostock, Memoir 218, pp. 21, price 10c. Also "Lake Etchemin Map-Area, Quebec," by Carl Tolman, Memoir 199, pp. 20 and map, price 10c. Sold by J. O. Patenaude, King's Printer, Ottawa.



Why it pays to Specify Birdsboro-Buchanan Crushers

3 Service Tests Reveal Actual Production And Power Consumption Figures

Recently a Birdsboro customer checked his crushing operations to determine a basis for assigning costs.

His equipment consisted of two standard Birdsboro-Buchanan Type C jaw crushers and the necessary storage and handling machinery. The plant was crushing material having a crushing strength of 50,000 lbs. per sq. in.

In the panel to the right, are the details of three service tests he made on these machines. Roughly, he found that he was getting almost double the rated production capacity from these Birdsboro-Buchanan crushers with no noticeable increase in power consumption. In addition, his records showed that repairs and maintenance expenses were under normal expectancy.

This customer's experience is like that of many other mine and quarry operators using Birdsboro-Buchanan crushers. They find these crushers able to reduce large quantities of tough material quickly and inexpensively. That's why it pays to specify Birdsboro-Buchanan crushers for rugged crushing strength.

Here are the Service Test results:

TEST 1. Crusher A, 7" breaker setting

Average time to crush a 7-yard (10-ton) carload ..... 40 Sec.

Average capacity over a 10-hr. period (incl. charging time) 600 Tons/hr.

TEST 2. Crusher A, 8" breaker setting

Average capacity over a 10-hr. period (incl. charging time) 450 Tons/hr.

Average of 100 horsepower tests ..... 131 HP.

Peak load horsepower..... 200 HP.

TEST 3. Crusher B, 5" breaker setting

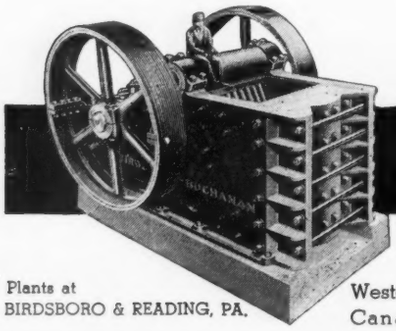
Average capacity 10-hr. continuous feed test..... 450 Tons/hr.

Average of 100 horsepower tests ..... 122 HP.

Peak load horsepower..... 150 HP.

RATED OPERATING CHARACTERISTICS

	Crusher A	*Crusher B*
Jaw opening	48" x 72"	36" x 72"
Tons/hour for sizes	347 for 7" / 396 for 8"	185 for 5"
Horsepower	150 — 200	125 — 150
Shovel sizes	3 — 3½ yds.	2 — 2½ yds.



For full details on the construction and operation of these practical Type C jaw crushers, write for Bulletin 110—there is no obligation.

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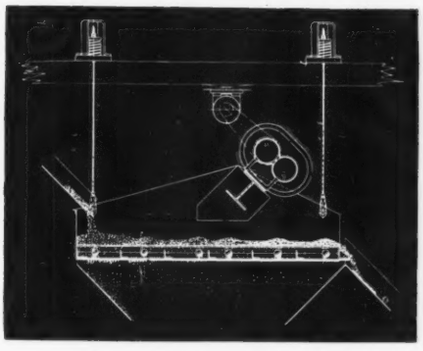
EQUIPMENT NEWS

Speed Reducers

STEPHENS-ADAMSON Manufacturing Company, Aurora, Ill., has added to its line of J.F.S. variable-speed reducers, a new line of constant-speed reducers under the trade name, Saco. These new units can be used with any standard, full-speed motor to give required output speed. The motor support is adjustable for V-belt drive, permitting sheaves to be replaced with ease to suit changes in required output speed. The shaft support construction is said to permit heavy over-hung load, and range of output speed varies from 13.2 r.p.m. to 172 r.p.m. Efficiency of these reducers is said to run from 89 to 93 per cent. All shafts are mounted in precision ball bearings and the precision cut helical steel gears operate in a constant bath of oil.

Vibrating Screen

ALLIS - CHALMERS Manufacturing Company, Milwaukee, Wis., has announced an interesting improvement applicable to the company's low-head screens for use where keeping fine mesh cloth clean is a problem. The screening of moist or wet material, such as fine crushed stone, and ore, usually causes blinding. This new development provides a secondary deck located several inches below the screen cloth. This secondary deck is



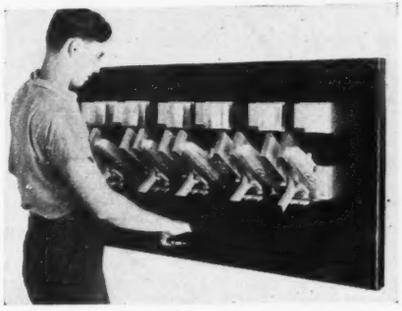
made of perforated metal having large holes. The space between the screen cloth and the secondary deck is divided into rectangular compartments each containing a special rubber ball. When the screen is in motion the rapid bounding of these balls between the decks causes a secondary vibration of the screening deck that prevents blinding without damage to the cloth.

Smaller A-C Magnetic Switch

A NEW a-c magnetic switch (CR7006-D51) has been developed by the General Electric Company, Schenectady, N. Y., for full-voltage starting of single-two-, and three-phase motors. Though it is small and compact, it has been designed in full accordance with established standards of electrical clearances, mechanical strength, and ratings. Its principal features, in addition to its small physical dimensions, are its conservative electrical design, long mechanical life, and low maintenance costs over a long period.

Three-Pole Hand-Operated Switch

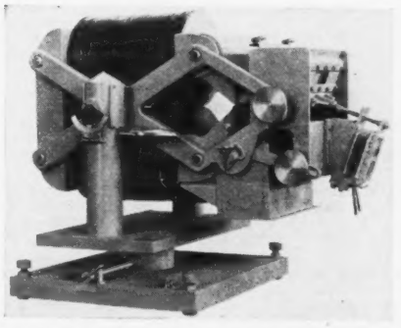
I-T-E CIRCUIT BREAKER Company, of Philadelphia, Pa., has recently completed a hand-operated, three-pole, 10,000-amp. disconnect switch. This



switch, as illustrated, is so constructed that all three poles are opened or closed in unison with considerable ease, thus constituting, in effect, the opening or closing of a 30,000-amp., single-pole switch. This singular engineering achievement which enables a switch of such high capacity to be operated by hand is incorporated in the patented "Klamp-Tite" feature.

Improved Magnetic Separator

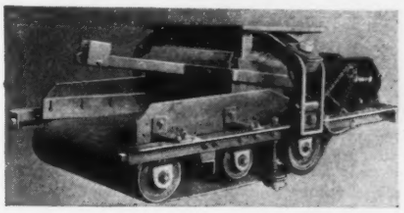
IN RESPONSE to a growing demand by industry for improvement in processing materials as well as securing higher recovery and a sharper division of values in the separation of minerals and ores, the Stearns Magnetic Manufacturing



Company, Milwaukee, Wis., has announced the design of a new magnetic separator to be styled "KS" Para-Magnetic Separator. It is designed for maximum concentration and the required number of fields can usually be incorporated in this type separator to provide complete separation in one operation. The magnetic fields are arranged for and adjustable to varying degrees of magnetic intensity.

Improved Constant Weight Feeder

HARDINGE COMPANY, INC., York, Pa., has announced an improvement in the Constant Weight Feeder, which per-



mits the use of 440- and 550-volt motors and gear motors on the feeder frame, itself, without resorting to separate transformers previously required, because of the flexibility of the connections employed.

This new flexible connection consists of an unusually flexible armored casting which meets underwriter's requirements. The change simplifies the feeder and is said to reduce costs in cases where higher voltage motors are desired. Recent reports of this feeder show a variation of less than one-half of 1 per cent in weight, when feeding $\frac{5}{8}$-in. ore.

New 1¼ Yd. Shovel

THREE outstanding new features which are said to meet all modern digging requirements are incorporated in the new

Marion Type 352 excavator recently developed by the Marion Steam Shovel Company, Marion, Ohio, and designed to handle jobs on which high speed, strength, and smoothness of operation are necessary, as well as power and durability. As a shovel, it is equipped with a 1¼ cu.yd. dipper.

New features by the manufacturer are: velvo-grip hoist and crowd clutches; vacuum-controlled dipper trip, and vacuum-controlled rotating clutches.

The velvo-grip hoist and crowd clutches are said to enable the operator to have the "feel of clutch" at all times, assuring smooth handling and accurate spotting of loads. This feature is especially valuable when the Marion is equipped for steel erection and other crane work.

This truck, reported to be the world's biggest, is a 43-yd. unit, powered by a 180 hp. "Caterpillar" diesel engine, and built by the Trojan Truck Manufacturing Company, of 620 E. Valley Boulevard, Alhambra, Calif. On a 4-mile haul, the truck is said to handle an average of 85 cu.yd. of material an hour, and do this work on approximately 3½ gal. of diesel fuel. An especially designed tail gate makes it possible to load the unit to its maximum capacity regardless of the type of material being handled. It unloads in 45 seconds by means of a sliding bulkhead in the body that pushes the load out and spreads it simultaneously.

BULLETINS

Dust Collector. American Air Filter Co. Inc., Louisville, Ky. Bulletin 274 describes features of the Type W Roto-Clone dynamic precipitator for application where dust must be collected. Pp. 15.

Inclosed Motors. Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles, Calif. Bulletin 142, describes improvements in the company's Klosed Motor containing the Sterling herringbone rotor. Pp. 3.

Modern Sulphur Mining. Texas Gulf Sulphur Co., 75 East 42 St., New York, N. Y. The company has issued an interesting booklet describing the method used in mining sulphur in its Gulf Coast deposits. A selected bibliography is also included. Pp. 27.

Rotary Kiln Sintering. F. L. Smidth & Co., 225 Broadway, New York, N. Y. Publication 1013 describes the use of sintering and nodulizing ore fines. Pp. 10.

Gyratory Crusher Wearing Parts. Hadfields, Ltd., Sheffield, England. Bulletin 412 describes parts made by the company for ore-crushing machinery. Pp. 16.

Clutches. Rockford Drilling Machine Division, Borg-Warner Corporation, 202 Catherine St., Rockford, Ill. Form O. C-100 illustrates and gives features of overcenter clutches that include the manufacturer's roller cam feature. Pp. 4.

Rod Mills. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1821-D describes the company's complete line of rod mills. Pp. 19.

"The Third Essential." The International Nickel Company, Inc., 67 Wall St., New York, N. Y. Booklet outlines a practical method for judging how well steam specialty equipment is made to give long service without repairs. Pp. 6.

Dust Collector. The W. W. Sly Manufacturing Co., 4700 Train Ave., Cleveland, Ohio. Bulletin 40 describes the manufacturer's cloth-type dust-filter equipment. Pp. 24. **Wet Dust Collector.** Bulletin 91 describes the "Centri Merge" wet-dust collector. Pp. 4.

Laboratory Mill. Raymond Pulverizer Division, Combustion Engineering Co., Inc., 1316 North Branch St., Chicago, Ill. Bulletin 38 describes a small laboratory motored swing-hammer-type crusher. Pp. 4.

Conveying Materials. Stephens-Adamson Mfg. Co., Aurora, Ill. Booklet entitled "The Labor Saver," Vol. 179, illustrates industrial uses of the company's products, especially material-handling equipment. Pp. 19.

Weightometer. Merrick Scale Mfg. Co., Passaic, N. J. Bulletin 388 illustrates and describes the Merrick Feedoweight, designed for use in feeding and proportioning materials into process at predetermined but variable rate. Pp. 12.

Rock Drill Lubrication. The Texas Co., 135 East 42d St., New York, N. Y. The booklet is entitled "Rock Drills, How to Keep Them Functioning." It describes and illustrates various types of the manufacturer's rock drills and how they should be properly cared for and operated. Pp. 36. **"Ball and Roller Bearing Lubrication"** is another booklet issued by The Texas Co., that describes and illustrates proper care of various manufacturer's types of ball and roller bearings.

Stripping. R. G. Le Tourneau, Inc., Peoria, Ill. Form G-1012 describes and illustrates equipment to meet all stripping, quarrying, and aggregate production problems. Pp. 8.

Boiler Feedwater. American K.A.T. Corp., 122 East 42d St., New York, N. Y. Folder describes features of a colloidal type compound for use in scale prevention and making clean steam. Pp. 11.

Mine Hoists. Nordberg Manufacturing Co., Milwaukee, Wis. Bulletin 83 is an attractive 8½x11-in. brochure describing and illustrating various sizes of mine hoists. Several pages are devoted to data on hoist design and calculations. Pp. 40.

Foot Injuries. Lehigh Safety Shoe Co., Allentown, Pa. Booklet illustrates and explains reasons for workmen injurying their feet and discusses features of the improved steel toe box on safety shoes. Pp. 27.

All-Wheel Drives. Marmon-Harrington Co., Inc., Indianapolis, Ind. Folder illustrates use of all-wheel-drive truck for snow removal. Pp. 3.

Cleaning Machine Parts. Oakite Products, Inc., 22 Thames St., New York, N. Y. Form 4401 describes uses of Oakite for cleaning machine parts. Pp. 35.

New Alloy. International Nickel Co., 67 Wall St., New York, N. Y. Folder describes "Z" Nickel, a new alloy said to have a strength of from 2½ to 4 times that of structural carbon steel. Pp. 1.

Meter Control. Bailey Meter Co., Cleveland, Ohio. Bulletin 102-B describes and illustrates the application of the Bailey Steam-Flow-Air Flow Automatic Readjustment type of air-operated combustion control. Pp. 32.

Metallizing Gun. Metallizing Engineering Co., Inc., 44 Whitehall St., New York, N. Y. Bulletin 37 describes and illustrates use of new Metco Metallizing Gun, Type E. Pp. 7.

Rust Solvent. Neilco Chemical Co., 5411-21 Cicotte Ave., Detroit, Mich. Folder describes "Galvo-Cleen," a product used for cleaning galvanized metal. Pp. 6.

Headlights. Ohio Brass Co., Mansfield, Ohio. Booklet 655 MD contains data on headlight designs for mine locomotives. Pp. 16.

Pumps. Victor Equipment Co., Kimball-Krogh Pump Division, 515 Harrison St., San Francisco, Calif. Bulletin 150 describes and illustrates the manufacturer's Type "MKE," two-stage, multiple-duty, high-pressure, mine-sinking, unwatering, and station pumps. Pp. 8. The improved Type "M" sand and tailings pump developed recently is described in detail in Bulletin 325. Pp. 8.

Water Softeners. International Filter Co., 59 East Van Buren St., Chicago, Ill. Bulletin 1850 is entitled "Infilco Hot-Flow Water Softeners for Boiler Feed Water Treatment" and is well illustrated. Pp. 16.

Diesel Tractor. Caterpillar Tractor Co., Peoria, Ill. Form 4876 describes and illustrates features of the manufacturer's largest D8 tractor. Pp. 31.

INDUSTRIAL NOTES

The Scomet Engineering Company has taken over the work formerly carried on by the Oxygen-Free Copper Department of the United States Metals Refining Company. There will be no change in the method of conducting the business, and the office at 420 Lexington Ave., New York, will continue to deal with all technical matters pertaining to oxygen-free copper. OFHC, OFRC Certified, and OFHC containing phosphorus will be produced at Carteret, N. J., and the American Metal Company, Ltd., 61 Broadway, New York, will handle the sale of the metal, as heretofore. The personnel of the organization remains unchanged.

Douglass R. Judd has joined the Pacific Coast staff of Nordberg Manufacturing Company, operating from the company's Los Angeles office. Mr. Judd will cover northern California and Nevada, making his headquarters at Oakland, Calif.

Denver Equipment Company has moved into its new building at 1400 17th St., Denver, Colo.

The Webster Manufacturing Company, Tiffin, Ohio, which for the past year has been operating under a trusteeship, was recently notified that its reorganization plan had been approved by the Federal District Court at Toledo, Ohio. The new company will be known as Webster Manufacturing, Inc., and remains under the present management.

L. H. Gilmer Company, makers of V-type and Kable Kord flat belting, Tacony, Philadelphia, announces its new Chicago office at 351-363 East Ohio St., in charge of A. B. MacFarland.

A new entry into the industrial roller-bearing field has just been announced with the appointment of Ahlberg Bearing Company as nation-wide distributor for the products of Bower Roller Bearing Company, of Detroit.

USL Battery Corporation finds it necessary because of a substantial increase in its volume of automotive battery business to devote the entire facilities of its Niagara Falls factory to the manufacture of automotive, radio, and farm-lighting batteries, according to a recent statement by H. A. Harvey, USL vice-president. Arrangements have been made with Gould Storage Battery Corporation, Depew, N. Y., to acquire the USL Power Battery Department and to continue for USL customers complete inspection and replacement service covering USL industrial batteries now in the field.

Aerial Tramways in the Metal-Mining Industry—III

STEEL and timber both are satisfactory for tramway structures. Steel lends itself more naturally to complicated designs. It also eliminates the fire hazard, and has numerous other advantages. Present tendencies are to use steel almost entirely, except in isolated localities. The first cost is from 40 to 60 per cent greater than for timber, but after a structure is once built it requires practically no attention.

Timber has certain advantages over steel, especially in places where it is impossible to get prompt deliveries of fabricated steel parts. Suitable timber generally can be obtained locally, and when such material is used construction of a tram can start as soon as any part is designed. With steel, construction must be delayed until the parts are fabricated and delivered, which is often three to six months. Such delays are serious in regions where the climate is severe and where construction work can be carried on during only five or six months of the year. Timber structures destroyed by fire or by snow slides usually can be rebuilt in from 10 to 30 days, whereas it might require months to replace a steel structure.

Timber structures require some attention after they have been completed. For the first year they should be inspected and the bolts tightened every 30 days. After the first year, this procedure is not necessary more than once every six months.

Concrete is preferable for foundation piers, although good masonry also is satisfactory.

Equipment

Carriers—Each carrier has three parts: The carriage or trolley, the hanger, and the bucket or rack for holding the material to be carried. The buckets used in metal mining generally are pivoted on the hangers and are discharged by dumping. In some coal-mining installations the buckets discharge from the bottom, which is latched and unlatched automatically at the point of discharge. For material such as timber, pipe and rails, special carriers must be used. These are often ordinary carriers with the hangers bent into the form of a rack or provided with chains for fastening the material being handled. On the smaller trams two carriers are generally used for a load of timber or rails. On larger trams, where four-wheel carriers are used, only one carrier is used for a load unless the material is extremely long.

Types of Cables and Couplings—Several kinds of cable have been developed by American manufacturers for use as track cables. The two most common are locked-coil cable and smooth-coil cable, both of which are satisfactory.

Track cables are generally made from a good grade of crucible cast steel. This is not quite as high in tensile strength as plow steel, from which hoisting cables usually are made, but it resists wear better and the wires do not break so soon. Because of their stiffness, plow-steel cables have a tendency to break down near the saddles where the bending stresses due to the rolling load are the greatest and because of repeated bending. Stranded cables should be avoided on account of the excessive wear they cause in the saddles and carriages.

Locked-coil cables and smooth-coil cables are made in lengths of 800 to 1,500 ft. For sections of tramway longer than this the cables are joined by couplings. These couplings consist of two round steel sockets from 8 to 12 in. long and as small in diameter as is consistent with strength. They are fastened together by a steel plug with right and left hand threads. One end of the bore of each socket is tapered so that the ends of the cable can be attached by means of wedges or molten zinc. Zinc is considered more satisfactory than wedges if the job is done under favorable conditions. If the job is done in the field under unfavorable weather conditions wedges are advisable. The couplings used for attaching the cables at tension stations, anchor stations, and terminals are similar in principle to the line couplings. They consist of only one socket for fastening the cable and are fitted with a swivel, link, or some other device for attaching to anchors or weights.

Saddles—In the early days of tramway construction, short saddles of the stationary type were the only kind known. Although this type gave satisfactory service, the rocking type of saddle is used today almost entirely on towers having only one point of support for the cables. Some manufacturers make saddles of the rocking type 4 ft. long. On rail structures, a combination stationary saddle and bracket is used. The bracket is for bolting the rail in place just above the point where the cable passes over the saddle. The carrier moves from the cable to the rail on a bonnet, one end of which is bolted to the rail and the other end of which rests over the cable. At the tension stations, anchor stations, and terminals, cross saddles and parting saddles (Fig. 7, in Part II) are used for deflecting the cables to points of anchorage or tension.

Grips—The best known grips for attaching the carriers to the traction cable are of three types. In the Otto type the gripping action is obtained by means of a lever and a screw. The screw is provided with threads having a steep pitch for about two-thirds of its length, the end having threads with a very flat pitch. The grip is adjusted by means of adjusting screws, so that the threads with the steep pitch will act until the gripping jaws are in firm contact with the cable, and from there the action is taken up and the final gripping is done by the threads with flat pitch.

The Weber grip works by a lever and toggles. The Wico grip is also worked by lever and toggles, but the gripping pressure is by springs. Both of these grips can be adjusted to the size of the cable by means of screws, but the Wico grip, because of the springs, adjusts itself to places on the cable that may be abnormally large due to splicing.

The Otto grip and the Weber grip can be operated by hand for attaching, but are usually detached automatically. The Wico grip must be attached and detached automatically.

Some grips are made to open from the top, some from the bottom, and some from the side. The rollers for carrying the traction cable at the terminals must be arranged in a slightly different manner for each type of opening. Local conditions vary so greatly that the arrangement of rollers for nearly every terminal presents a different problem.

Design of Aerial Tramways—Before a tramway of any kind can be designed, a careful survey must be made of the proposed route. The center line must be plotted accurately both in elevation and horizontal plan. The locations and height of the structures are determined from the profile. A careful topographic survey is then made at each structure location, and

the contours are plotted at 1- or 2-ft. intervals.

In figuring the height and locations of the structures, it is first necessary to make a thorough inspection of the plotted profile. By such inspection it is possible to locate certain obvious points for structure locations and from these proceed with calculations to make the rest of the locations. After the heights and locations of the structures are determined, they are designed to fit the topography of their respective locations.

Determination of Size of Cables. The size of the track and traction cables necessary for a tram of given capacity will be determined by the following factors: 1. The capacity of the tram per hour. 2. The speed of the traction rope. 3. The capacity and weight of the individual carriers. 4. The nature of the profile for which the tram is to be built. 5. The allowable sag or maximum deflection.

Any tram permits of a certain choice in rope speed and capacity of individual carriers. Since the loading on the line varies inversely as the rope speed, the size of the track cable required will be a minimum when the rope speed is a maximum. However, high rope speeds should be avoided whenever possible because of the difficulty of handling the carriers at the terminals. In tramway construction the tendency is to compromise on speeds from 450 to 500 ft. per min., or about 8 ft. per sec., although higher speeds are possible.

For a tram with a capacity of 90 tons per hour, a rope speed of 8 ft per sec., or 480 ft. per min., and carriers of 1,200 lb. capacity, the capacity per minute, the time interval, and the spacing are as follows:

Capacity per minute =

$$\frac{90 \times 2{,}000}{60} = 3{,}000 \text{ lb. or } 1\tfrac{1}{2} \text{ tons}$$

Time interval of carriers =

$$\frac{1{,}200 \times 60}{3{,}000} = 24 \text{ sec.}$$

$$\text{Spacing} = \frac{480 \times 24}{60} = 192 \text{ ft.}$$

If the weight of the carriers is 570 lb. and the loading is assumed to be distributed uniformly, the loading per foot due to the loaded carriers is

$$\frac{1{,}200 + 570}{192} = 9.22 \text{ lb.}$$

On spans where there are three or more loads, the defection or sag is nearly the same as if the loading were distributed uniformly. For most practical purposes, it is satisfactory to assume the latter. The size of the track cable necessary to support this load will be determined by the allowable sag or maximum deflection. The greater the sag the smaller will be the size of the cable required, as the tension varies inversely as the deflection or sag for any given load on a span. The allowable sag depends upon so many practical considerations that there is no definite rule by which it can be determined. For the purpose of showing calculations it may be taken as 1/19 on the longest span.

Ordinarily, it is not known accurately which is the longest span of a tram until all structure locations are known, and this, in turn, depends on calculating cable deflections for the whole line. However, the length of the longest span generally can be determined with sufficient accuracy for preliminary calculations.

From an inspection of the profile (Fig. 8), it is apparent that for the conditions shown, the supports or towers must be placed at horizontal distances of 1,400 and 2,800 ft. After the cable deflections for the spans, 0 to 1,400 and 1,400 to 2,800 are calculated and plotted, it may develop that intermediate supports are necessary, but it is evident that the longest span will be about 1,400 ft.

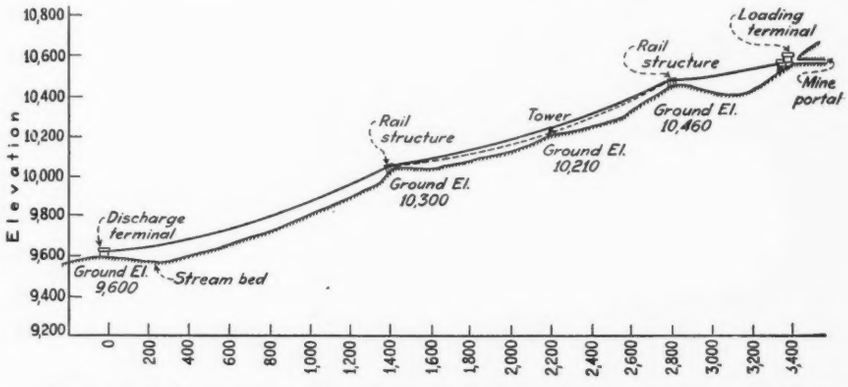


Fig. 8. Typical tramway profile. Towers located to provide a minimum clearance of 20 ft. for the track cable.

Considering the span from horizontal coordinate 0 to coordinate 1,400:

1/19 of 1,400—75 feet (approximately), which is taken to be the maximum allowable deflection for this span.

In the formula[2] $H = \frac{wmn}{2t \cos \alpha}$

= 74 ft. = allowable deflection at center of the span

w = total weight per foot of load and cable = 9.22 plus the weight of the cable per foot

m = distance of the point from left support = 700

n = distance of the point from right support = 700

t = working tension of cable

α = the vertical angle of the inclined chord

$$= \tan^{-1} \frac{\text{diff. elevation}}{1{,}400}$$

$$= \tan^{-1} \frac{10{,}030 - 9{,}600}{1{,}400} = 17^\circ\ 04'$$

The weight of locked coil cable per square inch of cross-section area per foot is 3.1 pounds (determined from data furnished by manufacturers).

The tensile strength of locked coil cable per square inch of cross-section area is 112,000 pounds and the working tension is 32,000 pounds (safety factor 3.5) (determined from data furnished by manufacturers).

Let A = the cross-section area of the cable required, square inches. Then 3.1A = weight per foot and 32,000A = working tension.

Substituting in formula (1)

$$75 = \frac{(9.22 + 3.1\text{A})\ (700 \times 700)}{2 \times 32{,}000\text{A} \cos 17^\circ\ 04'}$$

$$= \frac{4{,}517{,}800 + 1{,}519{,}000\text{A}}{61{,}184\text{A}}$$

A = 1.472 square inches

If d = diameter of cable, $\frac{\pi d^2}{4}$ = A = 1.472 square inches and d = 1.37 inches or $1\frac{3}{8}$ inches for the loaded side.

For the empty side, the distributed weight of the empty carriers is $\frac{570}{192}$ or 2.97 lb. per foot.

Substituting in formula (1)

$$75 = \frac{(2.97\ 3.1\text{A})\ (700 \times 700)}{2 \times 32{,}000\text{A} \cos 17^\circ\ 04'}$$

$$\frac{1{,}455{,}300 + 1{,}519{,}000\text{A}}{61{,}184\text{A}}$$

A = 0.475 sq. in. $\frac{\pi d^2}{4}$

d = 0.777 in. = the calculated diameter of the cable required on the empty side. Since locked-coil cables are made to the nearest $\frac{1}{8}$ in. and 0.777 in. is the minimum diameter for safe working conditions, the nearest size above must be used, which is $\frac{7}{8}$ in. If heavy supplies, such as timber and rails, are to be hauled on the empty side, it would be advisable to use a cable of 1-in. diameter rather than one of $\frac{7}{8}$-in. diameter.

(To be continued)

Excerpted from U. S. Bureau of Mines Information Circular 6948, entitled "Aerial Tramways in the Mining Industry," Part I. By O. H. Metzger.

[2] Peele, Robert, Formula (18): Mining Engineers' Handbook, 2d ed., 1927, p. 1749.